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ABSTRACT

This publication is part of a series of instructional units produced by NSTA's Project for an Energy-Enriched Curriculum. This unit presents the variety of transportation modes and tries to assist students in understanding the effects of transportation on their world. The main concern of the unit is with fossil fuel consumption. The seven activities presented here also include topics of pollution and transportation history. (MR)

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# Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy

# Energy and Transportation

## Grade 3

## December 1977

NATIONAL SCIENCE TEACHERS ASSOCIATION

Prepared for
U.S. Department of Energy
Office of Education, Business, and Labor Affairs
Under Contract No. EX-76C-10-3841

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November 1977
John M. Fowler
Project Director

DRAFT

# ENERGY AND TRANSPORTATION

## Introduction

Transportation, the movement of people and things from place to place, is one of those aspects of modern living so familiar to most young children that they are likely to take it for granted. The idea of this unit is to help students develop a conscious appreciation of the variety of transportation modes, past and present, and to assist them in understanding some of the ways that modern transportation systems affect their world.

Although the main concern of the unit is with fossil fuel consumption in modern transportation systems, the lessons contain other educational objectives as well. For example, the unit aims at giving students a glimpse into transportation's history in an effort to stress the fact that the internal combustion engine was not always the primary mode of travel. In addition, by investigating a number of transportation systems, the lessons try to give some idea of what is meant by "a system" and how systems work. The unit also deals with the concept of efficiency by showing that all transportation systems are not equally well suited for all tasks, and that choices must be made to select the mode of transportation that best fits a specific need.

The main focus of the unit, however, is on energy. The use and misuse of the automobile as a consumer of fossil fuels receives the lion's share of attention. There are over 100 million automobiles in the United States today. They consume 76 billion gallons of gasoline each year--about 14% of the total U.S. energy use. Although statistics like these may initially have little meaning for young children, teachers who understand the significance of these numbers can at least hope to begin developing a student's intuitive awareness of their magnitude and national importance. Ideally, this heightened awareness will result in a greater appreciation of the need to develop efficient transportation systems. As today's children approach

adulthood, the need for transportation efficiency will be made more and more important by the combined pressures of rising prices, resource scarcity, and the growing threat to our natural environment.

| Lesson | Contents |
|---|---|
| 1 | Movin' On<br>Students share their knowledge of transportation and discuss the ways in which they use it. |
| 2 | Olivia Oil<br>Students learn about the process of refining crude oil. |
| 3 | Cars Need Energy<br>Students examine different types of fuel for the internal combustion engine and discover the relationship between those fuels and engine power. |
| 4 | We've Got a System<br>The concept of systems of transportation is introduced. |
| 5 | Your Choice: Public or Private?<br>Students compare the cost in time and money of different types of transportation and then interview several people to find out how people in their community get to work. |
| 6 | Danger! Unfit for Human Use<br>Students collect data, interpret graphs and conduct an investigation to determine the types of pollution caused by transportation vehicles. Then they explore ways of controlling or reducing that pollution. |
| 7 | Looking Back - Looking Ahead<br>This unit glances at the history of transportation to show students the change that modes of transportation have undergone, and provides the opportunity for a discussion of future modes of transportation, keeping in mind the limited supply of energy and the effects of pollution on the environment. |

## Lesson 1 - MOVIN' ON

**Overview**

This activity introduces the concept of transportation. It reviews the various forms of transportation which are available for use and it defines the two basic purposes of transportation as the movement of people and the movement of things.

**Time Allotment**

One class period.

**Objectives**

Students should be able to:

1. Define the term transportation.
2. State the two basic purposes of transportation.
3. State at least three types of transportation which can be used for moving people.
4. State at least three types of transportation which can be used for moving things.

**Background Information (Teacher Use Only)**

There are two basic purposes to transportation: to move people and to move things. We may also categorize transportation as intercity transport (trips greater than 100 miles) and urban transport.

The job of moving people consumes 60 per cent of transportation's total energy. Urban passenger transport uses about 40 per cent more energy than intercity transport. Energy use is increasing more rapidly than passenger miles.*

**Materials**

Pictures of a variety of forms of transportation from magazines or study prints.
Chalkboard and chalk or chart paper and magic marker.
Models of cars, boats, planes, trucks, trains, etc. (Ask students for these.)

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* Energy-Environment Source Book, John M. Fowler, National Science Teachers Association, Washington, D.C., pp. 67-68, 1975.

**Teaching Strategies**

**Introducing the Lesson**

Begin the discussion by asking the class: "How did you get to school today?" *(List responses on the board.)* "Have any of you ever taken a trip to visit relatives? To sightsee? To go camping? Where did you go?" *(Allow time for a variety of responses.)* "How did you get there?" *(List responses on the board. Possible responses: car, van, boat, train, plane.)*

**Developing the Lesson**

Extend the discussion by asking: "What are some of the things people use to get from one place to another?" *(Add any new suggestions to the list on the board.)*

"Now I'm going to show you some pictures. Raise your hand if you know what it is." *(Show pictures or hold models of various forms of transportation and call on students to name each.)* "Does anyone know a word that begins with T that means moving people, by car, plane, train and so on?" *(Answer: Transportation. Write the word on the board. Ask the entire class to pronounce it. Discuss the root word: transport.)*

"Is there anything besides people that need to be moved from one place to another?" *(Possible answers: animals, food, clothing, furniture, machines, oil, letters, etc. List these on the board under the title Things.)* "What kind of transportation is used to move these things?" *(Possible responses: trucks, boats, planes, trains, etc. List these on the board.)*

Write this sentence on the board and ask students to fill in the blanks. *"I'm going to give you a picture and let's look at this picture and name all the kinds of transportation that we see."* Distribute the picture, On the Move, and call on students to identify the forms of transportation shown. *(Answers include plane, car, school bus, gasoline truck, produce truck, train, ship, person bicycling, people walking.)*

"Now look at the picture again and tell me which forms of transportation are used to move people. Which are used to move things? Which are used for both?"

"Let's make a chart that shows the kinds of transportation used to move people and things." Have each student complete his/her chart as the teacher records their ideas on the board.

## Transportation

| People | Things |
|---|---|
| *(Possible responses:)* | *(Possible responses:)* |
| 1. *cars* | 1. *cars* |
| 2. *bus* | 2. *bus* |
| 3. *motorcycle* | 3. *trucks* |
| 4. *bicycle* | 4. *train-freight* |
| 5. *train-passenger* | 5. *planes* |
| 6. *plane* | 6. *ships-freighters-tankers, etc.* |
| 7. *boat* | |
| 8. *metroliner* | |
| 9. *vans, etc.* | |

**Summarizing the Lesson**

"Let's talk about what we've learned today. See if you can fill in the missing words."

Write the three sentences on the board or a chart and have the students complete the sentences orally.

1. "Transportation is *(moving)* *(people)* and *(things)* from one *(place)* to another."

2. "Three kinds of transportation that move people are: _____, _____, and _____."
   *(Accept any three appropriate answers.)*

3. "Three kinds of transportation that move things are: _____, _____, and _____."
   *(Accept any three appropriate answers.)*

Remind each student to file his/her chart on transportation in his/her notebook.

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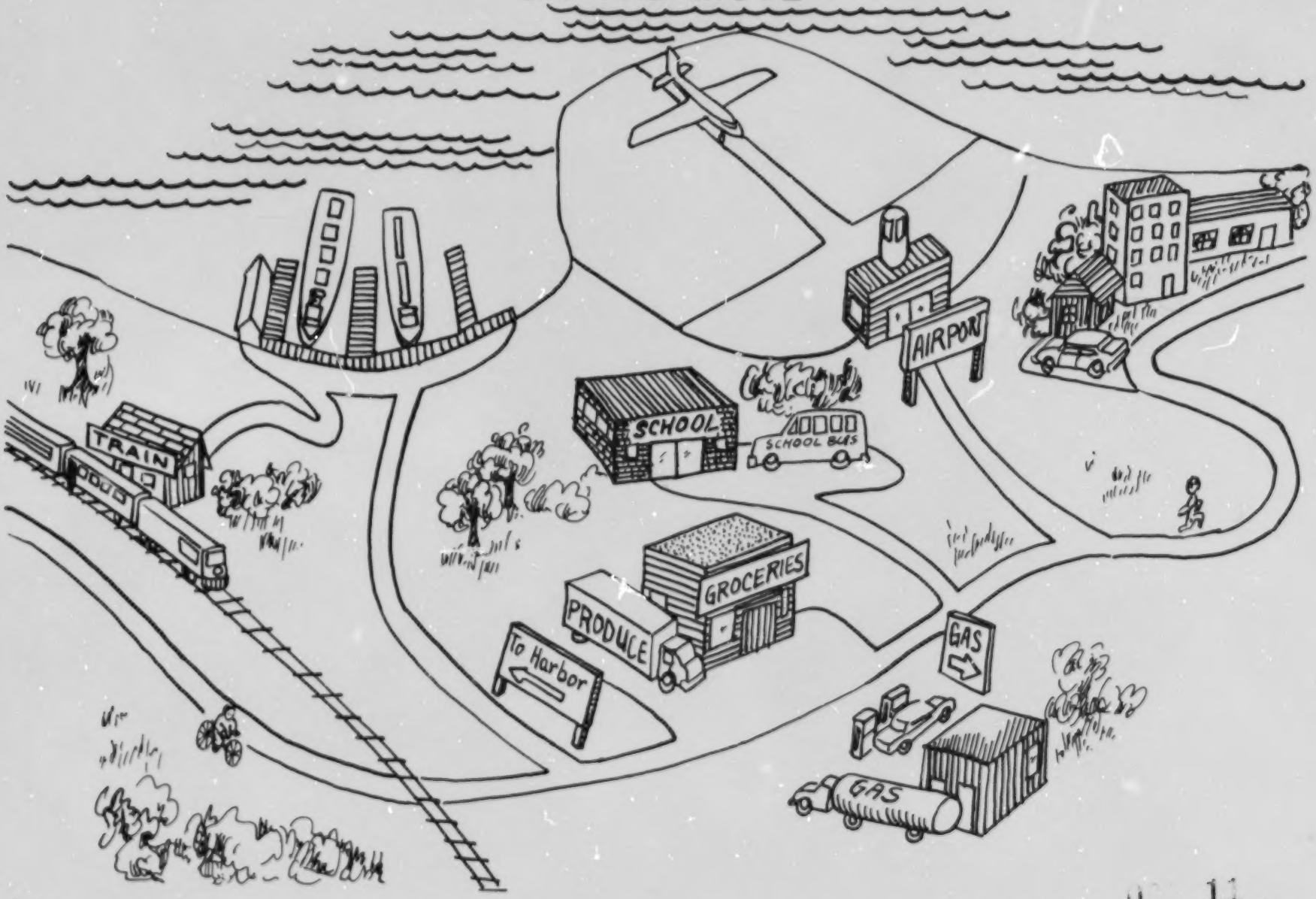
# ON THE MOVE


TRAIN
SCHOOL
SCHOOL BUS
AIRPORT
GROCERIES
PRODUCE
To Harbor
GAS
GAS

## Lesson 2 - OLIVIA OIL

**Overview**

This activity introduces oil as the raw material which is used to make most of the fuels used in transportation. A brief description of how oil is converted into gasoline, diesel fuel, and kerosene is given. The concept of using fuel to provide energy is introduced.

**Time Allotment**

One class period.

**Objectives**

Students should be able to:

1. Identify oil as the raw material for transportation fuels.
2. Sequence the steps from oil well to oil products.
3. Name at least two kinds of fuels made from crude oil.

**Background Information (Teacher Use Only)**

The first United States oil well, a well only 69.5 feet deep, was drilled in August 1859 outside Titusville, Pennsylvania. The United States was an oil exporting nation until the 1950's, but has increasingly become an importing one. In 1976 our crude oil imports made up 41 per cent of the total petroleum supply. The invention of the gasoline engines, in about 1880, produced the present dominant market for oil. Gasoline and fuel oil account for almost 90 per cent of the total petroleum market.

**Materials**

Chalkboard and chalk or chart paper and markers. Transportation chart developed in Lesson #1. The Story of Olivia Oil.

**Teaching Strategies**

"Yesterday we talked about transportation. Let's see what you remember."

**Introducing the Lesson**

Write the summary sentences from the previous lesson on the board and ask students to copy the sentences and fill in the blanks.

"Transportation is _____ _____ and _____ from one _____ to another."

"Three kinds of transportation that move people are: _____, _____ and _____."

"Three kinds of transportation that move things are: _____, _____ and _____."

Have each student correct his/her paper as you call on a student to fill in the blanks. Ask students to file this paper in his/her folder or notebook.

Developing the Lesson

Ask students to locate their transportation chart from the previous lesson. Using the chart ask students:

"What makes a car run?" *(Possible responses: engine, gasoline, etc. If gasoline isn't suggested, ask "What do we put in the engines to make it run?")*

"Look at your chart and name other kinds of transportation that use gasoline to make them run." *(Possible responses: motorcycles, boats, vans, etc. Allow students to include trucks, busses, airplanes if they do not know about diesel fuel.)*

"Do all these forms of transportation use gasoline? What else is used?" *(Possible responses: diesel fuel, kerosene, oil, etc.)*

"How do we make gasoline?" *(List ideas on the board.)*

"I'd like us to read a story today about how gasoline is made."

Distribute copies of The Story of Olivia Oil and ask different students to read each section orally while others read quietly.

After the story has been read aloud, discuss the story by asking:

1. Where is oil found? *(Ground.)* Do you think it is found everywhere or in special places? *(Special places.)*

2. What kind of transportation is used to move oil over water? *(Oil tankers.)* How is it moved over land? *(Pipe lines.)* Has anyone heard anything about the Alaskan Pipeline? *(Pipeline is completed. It has been shut down several times since it opened.)*

3. What is oil called when it is first found? *(Crude oil.)* What is it called after it has been to the refinery? *(Gasoline, heating oil, diesel fuel, kerosene.)*

4. Do you think we use a lot of oil in our daily lives? Give reasons.

5. What does fuel mean? *(Use dictionary if necessary. Fuel may be defined as something that is burned to make heat or power.)*

**Summarizing the Lesson**

Write the following sentences on the board and ask the students to copy them in the correct order. Students may refer to The Story of Olivia Oil if they need to do so.

1. I'm sent by pipes or tankers to the refinery.

2. I become gasoline, diesel fuel or oil.

3. I begin as crude oil in the ground.

4. At the refinery, I'm changed into other things.

Students may also make a drawing of the four steps. File the sentences for the next lesson.

**Extending Learning Activities**

Have able students locate oil fields on a U.S. map.

Invite a geologist to visit the classroom and to explain his/her role in finding oil.

Visit an oil refinery.

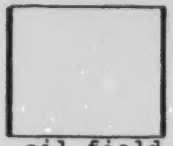
Have students read and report to the class what happens at a refinery.

Find articles about the Alaskan pipeline and discuss them in class.

Find articles related to an oil spill from an oil tanker and discuss in class.

# The Story of Olivia Oil

Hi! I'm Olivia Oil. People tell me I'm very important because I help people. To learn how I can be useful, read my story.

1. 
oil field

To find me you must look in the ground. First dig a deep hole. Then use a pump to pull me from the ground. I am called "crude oil" now.

2.
pipeline

Next I go on a trip. I am put in a pipeline (like the Alaskan Pipeline).

OR

3.
tanker

I am put in a big ship called an oil tanker and sent to a refinery.

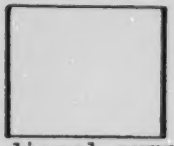
4.
refinery

A refinery is a place where I am changed into ....

5.
gas pump

...gasoline for use in cars, busses and taxis...

OR

6. 
diesel pump

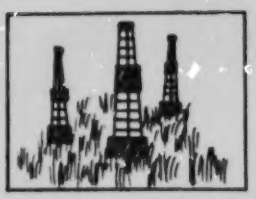
...diesel fuel for use in trucks, cars, and ships

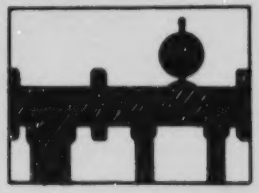
7.
furnace

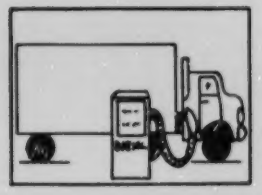
...oil for heating homes

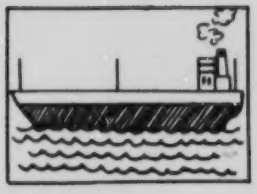
8.

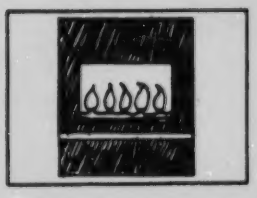
From the refinery, I travel by truck to wherever I am needed.

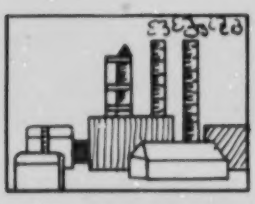












OIL

## Lesson 3 - CARS NEED ENERGY

**Overview**

Students define and extend their concept of energy. The operation of a gasoline engine is briefly explained in simple terms to help students' understanding that fuels are a source of energy and when fuels are burned they release their power and enable the machine to function.

**Time Allotment**

One or two class periods.

**Objectives**

Students should be able to:

1. Describe at least one type of fuel made from crude oil.
2. Trace the route of gasoline through a diagram of a car's engine.
3. Name at least one form of transportation that uses gasoline and diesel fuel for fuel.
4. State the relationship between fuel (potential energy) and power (kinetic energy), i.e., when fuel is burned it provides the energy to make the car move.

**Background Information (Teacher Use Only)**

A brief explanation of how a gasoline engine operates is as follows:

In a gasoline engine two things happen. A mixture of gasoline and air is burned which changes the energy stored in the gasoline (potential energy) into heat energy. This heat energy is then changed into mechanical energy (the energy that moves things) by the piston.

The piston moves in a cylinder and there are from 4 to 8 piston cylinder arrangements in each car (that is why they are called 8 cylinder engines, V8's, etc. Airplane and truck engines may have more cylinders.). In the typical gasoline engine the piston makes four strokes in each cycle. The valve opens and the piston moves down drawing the gas-air mixture into the engine. The valve closes and the piston moves back up compressing this fuel. When the fuel is compressed, a spark ignites it and it explodes. The burning mixture expands pushing the piston down again. This is the power stroke which turns the engine and drives the car. On the fourth stroke the piston comes back up, the valve opens, and the burned mixture, the exhaust, is forced out.

**Materials**

Approximately one cup of gasoline, diesel fuel, refined oil and kerosene in individual jars and labeled appropriately.

Diagrams: Energy for Cars (provided in packet.)

Access to automobile for use in demonstrating how gasoline and oil provide the energy for operating a gasoline engine (optional).

**Teaching Strategies**

**Introducing the Lesson**

Begin the lesson by having students correct the assignment from Lesson #2 in which they sequenced the story of how crude oil is converted into oil products. Allow students to discuss briefly The Story of Olivia Oil and review the terms: fuel, gasoline, kerosene, diesel fuel and refined oil.

On a table or desk have the four glass containers of diesel fuel, gasoline*, kerosene and refined oil. Ask different students to read each label. Allow them to come to the table in small groups - smell and touch each type of fuel. Ask:

-Which is the thickest?

-What color is each?

-Which have a strong smell?

-How are they alike? *(Liquids, all are types of fuel.)*

-Describe gasoline, oil, diesel fuel, and kerosene. What is used to make gasoline? *(Crude Oil.)* Kerosene? *(Crude Oil.)* Diesel fuel? *(Crude Oil.)* Refined Oil? *(Crude Oil.)*

-Why do we need these fuels? *(They provide the power to make the cars, trucks, etc. run.)*

-As they are now, are the fuels making anything move? *(No.)* What must happen for them to make a car move? *(Allow students to state their beliefs and do not correct misconceptions at this time.)*

**Developing the Lesson**

"Today we're going to take a look at what happens inside a car's engine and find out how gasoline helps the engine work."

Distribute copies of Energy for Cars. Use enlarged diagrams or transparency of this diagram to explain how the gasoline provides the power or energy to make the engine operate.



* Be very careful of the gasoline. It could explode if any flame comes near it.

Ask such questions as:

-Where is the engine located in this car? *(Front.)*
-Where does the gasoline enter the car? *(Filler pipe at back of car. Point to the filler pipe.)*
-Where is the gasoline stored in the car? *(Gasoline tank.)*

Let's trace the path of gasoline as it moves through the engine. You use your finger to trace the route as I point to the diagram. (Trace the gasoline through the gas line to the fuel pump, into the carburetor, into the cylinders of the engine. Use the correct terms for the parts of the engine, but do not expect students to remember them.) If students are interested in learning more about how an engine works, use diagram Inside a Gasoline Engine[1] to explain how gasoline provides the power to move the car. Continue to trace the path of gasoline pointing to the exhaust pipe through which the waste gases escape. Trace the route two or three times so that students become familiar with the process. Continue discussion by asking:

-Name some types of transportation that use gasoline for power. *(Cars, motorcycles, vans, taxis, etc.)*

-Name some that use diesel fuel. *(Trucks, ships, some cars, buses, etc.)*

If considered appropriate, use the Inside a Diesel Engine[2] diagram and compare the gasoline and diesel engines.

-What must happen to the gasoline or diesel fuel to release its power? *(It must burn.)*

**Summarizing the Lesson**

End this lesson by taking the students to the school parking lot and allowing them to locate the parts of the car that they discussed when using the diagram. Start the engine and lift the hood of the car so that students may see the engine in operation. Be sure to have sufficient adult supervision during this activity. Parents or other teachers may be helpful.

**Extending the Lesson**

Students may draw a picture showing how gasoline moves through a car.

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[1]Zim, Herbert S., What's Inside of Engines. William Morrow and Company, New York, 1953, pp. 10-11.

[2]Ibid., pp. 14-15.

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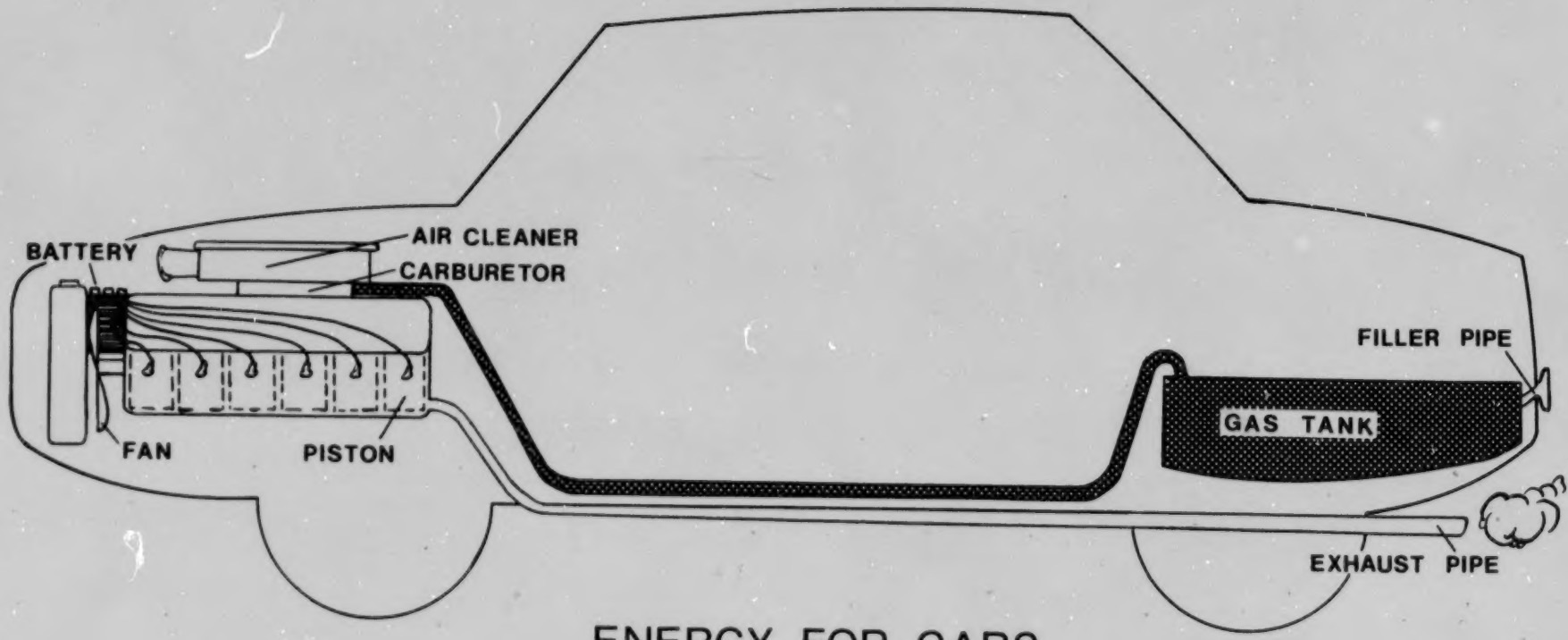


ENERGY FOR CARS

## Lesson 4 - WE'VE GOT A SYSTEM

**Overview**

In these lessons the concept of a system is introduced. The students identify the parts of various systems. The dependency of the parts on each other enables the system to operate. They examine samples of urban and rural transportation systems and design a simple transportation system.

**Time Allotment**

Two class periods.

**Objectives**

Students should be able to:

1. Describe a system.
2. State an example of an urban transportation system.
3. State an example of a rural transportation system.
4. State the relationship of a transportation system to energy, i.e., transportation systems depend on energy (oil) to make them go.

**Background Information (Teacher Use Only)**

A system is a network of many connecting parts. In almost every community in America, rural or urban, there is some system of transportation. The needs of the community play a major role in how complex the transportation system may become.

**Materials**

Flashlights. (Request students to bring flashlights to class for this lesson.)

Pictures - Rural Community, Urban Community (provided in packet).

**Teaching Strategies**

Begin the lesson by holding a flashlight in front of the students and asking:

**Introducing the Lesson**

-What am I holding?

-When do people use a flashlight? *(Possible responses: When electricity is off, on camping trips, in the woods, at night, etc.)* Turn flashlight on and off a few times.

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-Have you ever looked inside a flashlight? What do you think we'll find if I open this one? *(Possible responses: batteries, light-bulb, glass, reflector, etc.)*

"Let's open this one and see what's inside." (Open the end of the flashlight and hold each part and ask students to identify the parts.)

"Now that we've taken it apart, I'm going to put it together again." (Replace batteries incorrectly so that flashlight will not operate.) Ask a student to turn on the flashlight. When it doesn't light, ask why this happened. *(Possible response: batteries were put in wrong, battery is no good, etc.)*

Tell the class that you are going to give each group (or every three students) a flashlight. They are to open it, remove the parts and figure out how to replace them so that the flashlight works.

Distribute the flashlights and allow each student to take it apart and put it together correctly. Allow about 10 minutes for this activity.

**Developing the Lesson**

Draw an outline of a flashlight on the board and select students to label the parts. (See outline on next page.)

-What enables the flashlight to work? *(Acceptable answer: Putting parts together correctly.)*

-What causes the flashlight to stop working? *(Acceptable answer: Putting the batteries in incorrectly.)*

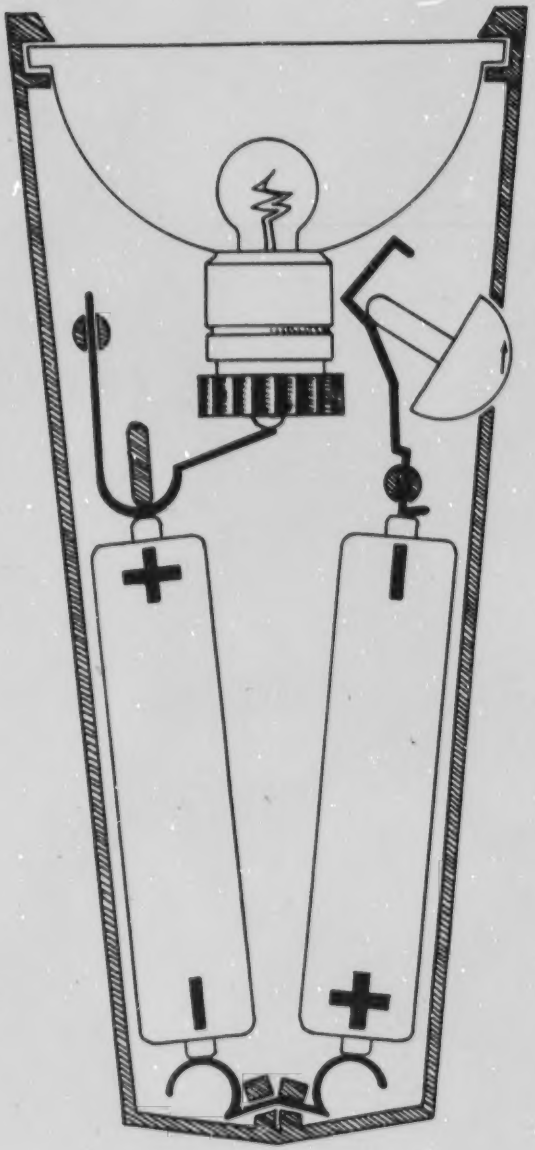
"When we put something together in a certain way, we say we have a system. Have any of you heard the word system? How was it used?" Allow students to discuss what they know about systems.

Continue by asking:

-We have been studying about transportation. Do you think there could be a transportation system? *(Yes.)* What would it be like? *(Allow students to hypothesize or to state what they know about transportation systems.)*

Tell the students that you are going to distribute two pictures and that you want them to examine the pictures carefully to answer two questions:

FLASHO



-What are the parts of this transportation system?

-How does the system work?

Discuss each picture. Have them determine that one is in the country or is a rural community and one is in the city or is an urban community.

Note: You may vary this activity by dividing the class into two groups: rural and urban.

Allow students five minutes to examine the pictures, then ask:

-What are the parts of the urban transportation system? *(List these on the board under Urban System. Answers include: airplane, bus, train, subway, cars, bicycles, people walking.)*

-How does the system work? *(Have students pretend to be going to the movies, to the park, etc. and have them describe various ways of going, i.e. walk to the bus stop, take bus, walk to park or take a taxi to train, train to bus, walk from bus to movie.)*

Ask the same two questions about the rural system and record answer under title Rural System on the board. Continue the discussion by asking:

-What is carrying things or goods in both pictures? *(Trains, pick-up truck, grain truck, stock trucks, the airplane and the oil truck.)*

-Which is carrying people? *(School bus, cars, bikes, horse, snowmobile, bus, taxi, plane, subway, streetcar, and the motorcycle.)*

-What kind of work do you think people do? Give the people who do work a name. *(Truck driver, bus driver, farmer, businessman, railroad engineer, pilot, taxi-cab driver.)*

-How do the ways people live help them decide what kind of transportation system they need? Why might you not see a subway in the country? Why might one taxi do the job in the country? Why wouldn't you need a whole lot of taxis in rural places?

Conceptualizing Energy Dependence in Transportation Systems

Look at the picture again. Then discuss these questions.

-Which transportation systems depend on gasoline? *(Car, truck, bus, taxi, school bus, snowmobiles, train, plane, motorcycle.)*

-Which kinds of transportation depend on using food for energy? *(Horse, people walking and biking.)*

Summarizing the Lesson

Write the following sentences on the board. Have students read them, fill in the blanks and copy them in their notebook.

A system is made of many *(parts)* which *(work)* together to make the system *(go)*.

Parts of a city transportation system are _____ and _____. *(Any acceptable answers.)*

Parts of a rural transportation system are _____ and _____. *(Any acceptable answers.)*

Extending the Lesson

Collect pictures of examples of transportation vehicles and group them urban and rural.

Invite a bus driver, train engineer, taxi driver or any other person involved in a transportation system and have him/her explain how the system works and what he/she does on the job.

Have students do research on transportation occupations and report to the class.

Role play the problems and fun of using a train, subway, bus, airplane, or taxi for the first time.

DAY # 2

**Teaching Strategies**

Review what was taught in the previous lesson re: a system, examples of urban transportation system and rural transportation system.

**Developing the Lesson**

Begin by asking the students:

-What kind of energy makes the transportation system? *(Acceptable responses: gasoline, food, electrical, etc.)*

Let's look at our urban and rural pictures again and this time, write a G if gasoline provided the energy; F if food provided the energy and X for any other types of energy which were used.

Allow five minutes for students to mark their pictures. Correct the assignment and discuss the dependency of our transportation systems on energy sources - primarily oil.

Continue lesson by distributing a copy of System Scramble to each student. Discuss how to find the hidden words in the puzzle. Words may be:

```
TRAIN   T   T         N
        R    R    or  I
        A     A        A
        I      I       R
        N       N      T
```

As they find each word, they should check it off on the list. Allow 5 or 10 minutes for this activity and then correct it.

**Summarizing the Lesson**

Have each student indicate that they understand how a transportation system works by drawing a picture story of:

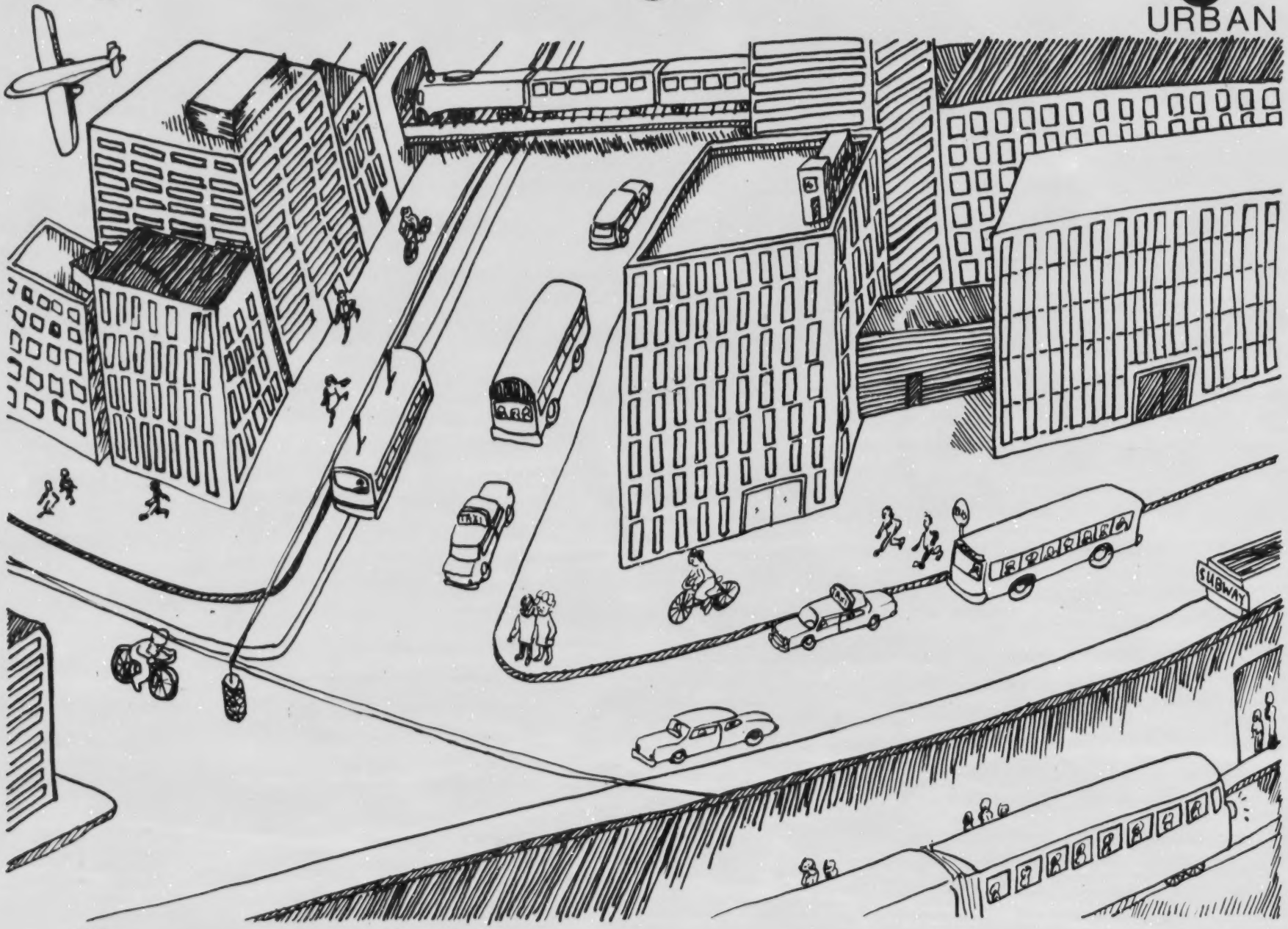
-How a food (corn, apples, etc.) is transported from the field to the table.

OR

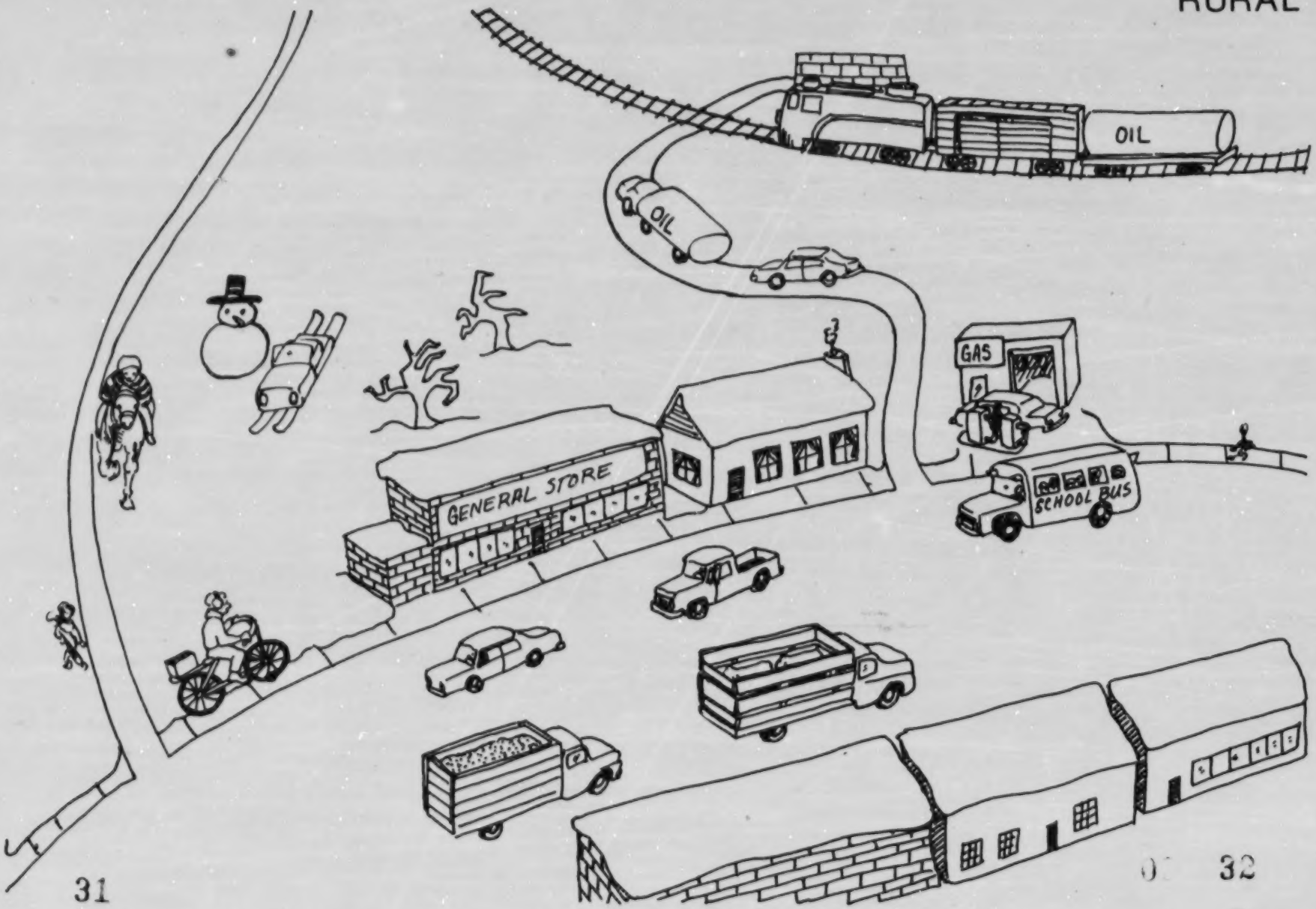
-How a person takes a vacation and uses at least three different forms of transportation.

Allow time for students to share these with the class. Post these in the classroom.

# URBAN



# RURAL



## SYSTEM SCRAMBLE

T B S O M B H G O F
T R U C K I U A A Z
V C B O L C K S N N
T A W I A Y A O M A
A G A L N C C R I V
X P Y W A L K I N G
I P L A N E N N O G
P I C K U P V E I T

__van
__bus
__walking
__truck
__taxi
__pick up
__subway
__plane
__oil
__gasoline
__bicycle
__car

## Lesson 5 - YOUR CHOICE: PUBLIC OR PRIVATE?

**Overview**

In this lesson students compare the costs of various forms of transportation and become aware of the need to use energy resources wisely. They distinguish between "public" and "private" types of transportation and discuss the advantages of using each. They also gather data regarding the transportation patterns in their community and practice decision-making on the wise use of energy resources for transporting people.

**Time Allotment**

Two class periods.

**Objectives**

The student should be able to:

1. Name at least two types of public and private transportation.
2. Chart transportation data.
3. Interpret transportation data and reach a decision based on the data.

**Background Information (Teacher Use Only)**

There are more than 100 million automobiles in the U.S. These automobiles use some 76 billion gallons of gasoline each year - or about 14% of all the energy in the U.S., almost 3/4 of all gasoline used and 28% of all petroleum or oil. The importance of individual gasoline savings cannot be over emphasized.

Public transportation systems, the bus, subway, train, etc. grew from a need in the larger cities. During World War II, rationing of gasoline drove people to use public transportation instead of the car. But after the war people began to use the car because of comfort, convenience, and at that time low operating cost. Public transportation was for those who could not afford a car.

Several factors played a major role in the increased interest in public transportation in the 70's: the gasoline crisis, the energy crisis, and the growing knowledge that the gasoline engine was damaging to our environment.

Our living space, our energy resources, our atmosphere all are consumed by the auto. (Transit Fact Book, page 22, American Public Transit Association)

As a result, more and more people are realizing the need for mass transit in the urban area. It is necessary to increase the quality of our lives in urban centers. Ridership is increasing as more people are attracted to mass transit.

For more information:

"The History of Transportation" (filmstrip)
Part 1 and 2
U.S. Department of Transportation
Washington, D.C.

Transit Fact Book
American Public Transit Association
1100 - 17th Street, N.W.
Washington, D.C. 20036

**Materials**

Provided in packet:

Picture - Mr. Hernandez Goes to Work "
Chart - Cost of Getting to Work
Questionnaire - How People Get to Work

**Teaching Strategies**

Begin the lesson by asking:

**Introducing the Lesson**

-How do members of your family get to work each day? *(List responses on the board.)*

-Have you heard of any other kinds of transportation? *(Responses should include: car, bus, train, metroliner, motorcycle, bicycle, walk, etc.)*

-Which of these types of transportation are "public" transportation? *(Help students to distinguish between public and private means of transportation.)*

Let's look at our list and label the forms of transportation - private or public. *(Select various students to label each form of transportation. Private - car, motorcycle, bicycle, walking. Public - bus, train, metroliners, subways.)*

-Which do you think costs the most per mile? *(Have each student raise his hand to indicate his choice.)* Is this a public or private form of transportation? Which do you think costs the least per mile? *(Again, ask each student to vote for their choice.)* Is this a public or private form of transportation? *(Expected answer: public.)* If public transportation seems to be cheaper, why don't more people use it? *(Possible responses: it's not available, it's not close to home, the schedule doesn't fit your needs, it's too slow, etc.)*

**Developing the Lesson**

"Today, let's find out how much it does cost to go to work by car, by bus, or by train."

Distribute copies of Mr. Hernandez Goes to Work and chart Cost of Getting to Work.

"Locate Mr. Hernandez's house. Let's suppose that Mr. Hernandez just moved into this house and he is trying to decide how he should go to work. Locate Mr. Hernandez's office. *(Have students point to correct office building.)* Mr. Hernandez has three choices. He can drive his car, take a bus, or take a train. Look at the chart called Cost of Getting to Work and compare the amount of money and time it takes for each form of transportation. Then you decide which you think is best. Use a pencil to trace the route you have chosen on the drawing."

Have one student read what is on the chart and discuss all terms used, i.e. "other costs" under car refer to insurance, repairs, replacement, etc. If necessary, work with small groups who need help with the assignment, while other students complete it independently. Write car, train, bus, on the board at the end of the allotted time. Ask:

-How many of you decided that Mr. Hernandez should use a car? *(Write number by car.)* A bus? *(Record number.)* A train? *(Record number.)*

Call on three students and have each go to the board and work the problem related to the total cost of using the car, bus, and train.

*Answer:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Car* | *Gasoline* | *$1.30;* | *Bus* | *$ .60* | *Train* | *$ .80* |
| | *Parking* | *2.00* | | *.60* | | *.80* |
| | *Other* | *.70* | | | | |
| | | *$4.00* | | *$1.20* | | *$1.60* |
| | *Time* | *25 min.* | | *35 min.* | | *20 min.* |

Allow time for students to discuss reasons for their choices. Ask:

-"Which type of transportation is less costly per mile: private or public?" *(Public.)*

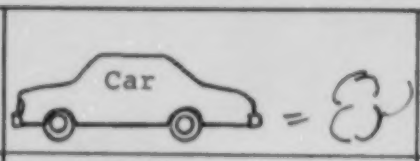
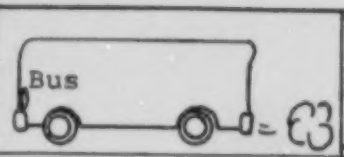
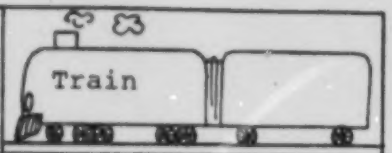
-"Which do you think most people use?" *(Allow students to hypothesize and accept any answer they give.)* "Let's find out which type of transportation the people in our community use."

Distribute How People Get to Work and read the three questions. Give the class the assignment of asking any two adults the three questions and record their answers. They may ask family, neighbors, friends, teachers or any member of their community.

Summarizing the Lesson

"What did we learn about the cost of getting to work today?" *(Car costs more per mile than train or bus.)* "Why do many people still use cars to get to work?" *(Possible responses: convenience, habit, good public transportation not available.)* "It will be interesting to see how the people in our community get to work. Don't forget to do your assignment."

## Costs of Getting to Work

| Type of Transportation |   |   |   |
|---|---|---|---|
| Costs | Gasoline: one-way $ .75<br>Parking 2.00<br>Other cost .50<br>Total Costs | Fare: one-way $ .60<br>Total Costs | Fare: one-way $ .80<br>Total Costs |
| Time | One way 25 minutes | One way 35 minutes | One way 20 minutes |

Work the problems below:

1. How much does it cost Mr. Hernandez to go to work and come home by car?

2. By bus?

3. By train?

4. How many minutes does it take him by car? by bus? by train?

5. Which do you think he should choose?

## How People Get to Work

How far away from home is your place of work?

1st person _____

2nd person _____

How do you get to work?

1st person _____

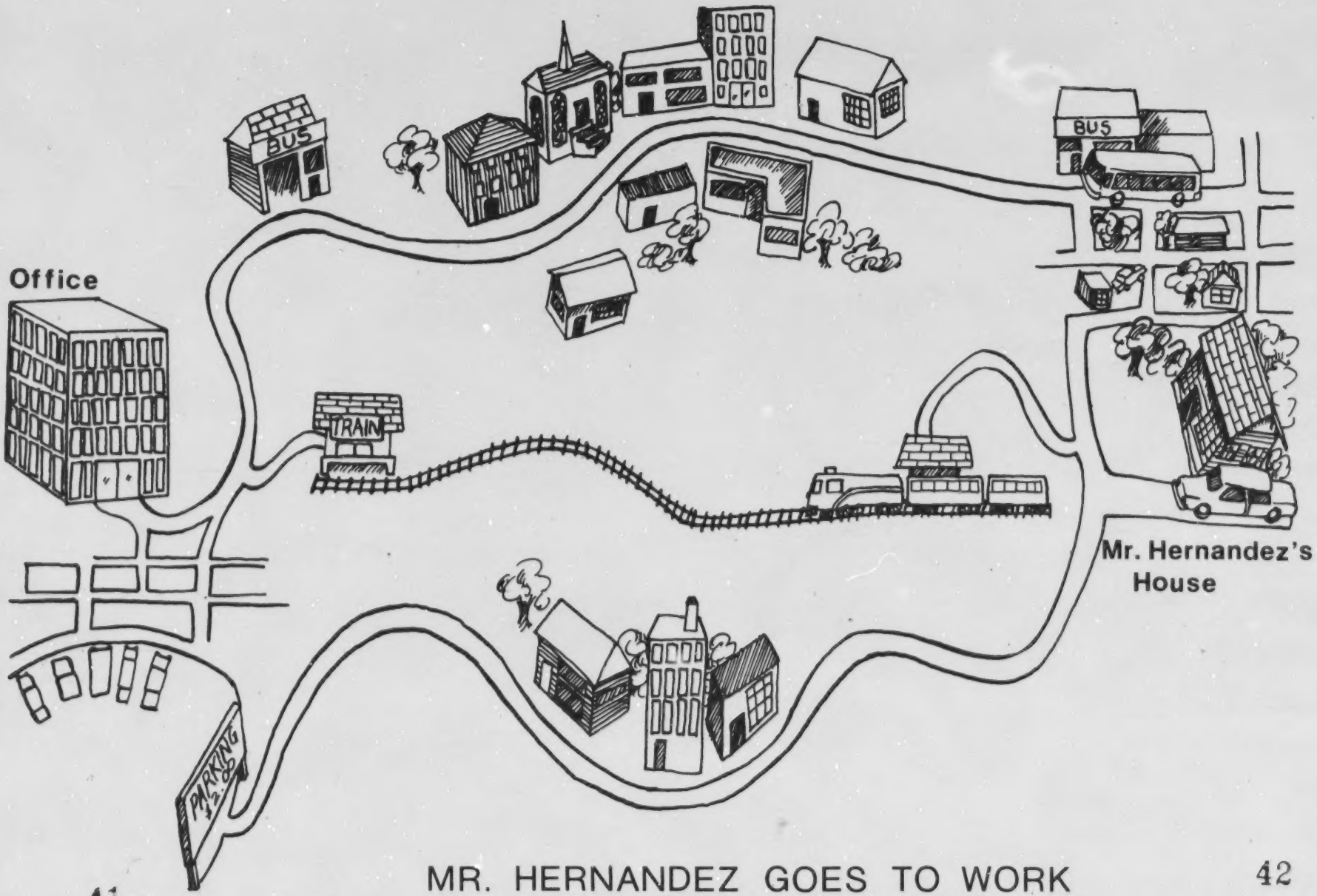
2nd person _____

How much does it cost you one-way?

1st person _____

2nd person _____

32




MR. HERNANDEZ GOES TO WORK

DAY #2

**Teaching Strategies**

**Introducing the Lesson**

Have the following charts on the board:

Cost of Getting to Work

| | Car | Bus | Train | Other |
|---|---|---|---|---|
| Less than 1 mile | | | | |
| 2 - 5 | | | | |
| 5 - 10 | | | | |
| 10 - 15 | | | | |
| 15 or more | | | | |

Begin lesson by asking students to locate their questionnaires and be prepared to discuss the results.

**Developing the Lesson**

Ask:

- How many people travel to work by car? *(Record total by car. Do the same with bus and train. Discuss the other forms of transportation used and record total.)*

- Now look at the number of miles each person traveled. How many traveled one mile or less by car? How much did it cost? *(Enter this on chart and continue until all information is categorized. Or divide students into four groups: Car, Bus, Train, and Other and allow them to record the information.)*

When chart is compiled, ask:

- What kind of transportation is used by most people? How many miles do most people travel? What do most people spend to go to work? Which type is most expensive? Least expensive? Which would save energy? Which do you think is the best way for people to go to work? How could the cost of driving cars be reduced? *(By car pooling, buying cars with better gas mileage, etc.)*

-In our last lesson we found that Mr. Hernandez spent $4.00 per day to drive his car to work. If he car pools and another person shares his cost, what will each pay? *($2.00)* If three people ride with Mr. Hernandez, what will each pay? *($1.00)*

Look at the chart Cost of Getting to Work and ask:

-Which form of transportation uses the least amount of gasoline? Which uses the most? How can people save oil and energy? Which form of transportation is best when you consider time, cost and the amount of oil or energy used?

Summarizing the Lesson

Write these sentences on the board and have students use charts to fill in the blanks.

1. Most people in our community go to work by _____.
2. Most people travel _____ miles to work.
3. The most expensive way to go to work is _____.
4. The kind of transportation which saves the most energy is _____.

Extended Learning Activities

Have the students and a parent volunteer or aide, go in groups to a nearby intersection or even the school parking lot as they come to school. How many cars have only one passenger? How many cars have two passengers? Three? More? Make a simple horizontal bar graph or a simple picture graph to show what they found. (Thirty minutes or less is enough time for this activity.)

Have the students solve the following problem.

Your family is going to take a vacation to Los Angeles, California. How would you go, by car, bus, airplane, or train? Find out how much it would cost for each kind of transportation. *(You may wish to localize here and use some place closer to home for the students.)*

(Note: If the children need more work on efficiency this activity should be used.)

## Efficiency Problem

The students will need one quart milk container, and one 1/2 pint milk container (school lunch size). You may use sand or water to fill both containers and let the children think of the sand or water as gasoline. Also place blocks or floating objects in the containers.

The quart container is a bus that can carry 12 passengers 10 miles.

The 1/2 pint is a car that carries 1 passenger 10 miles. (Note: This is if the car gets 10.5 miles per gallon.)

Have the children determine by using the 1/2 pint container how many of these would fill the bus.

Then ask them to find out how many trips the car would have to make to get twelve people to the same place as the bus, if it only carried 1 passenger. *(12)*

Then ask: "If the car carried 4 passengers, how many trips would it have to make to get 12 people to the same place as the bus?" *(3 trips.)*

If the car and bus are going to the same place, then which one saves on gas? Which one can carry more passengers and make less trips? Which one is more efficient?

## Lesson 6 - DANGER! UNFIT FOR HUMAN USE

**Overview**

This series of lessons examines the types of pollution caused by the use of energy in various forms of transportation. Students are involved in collecting data, interpreting graphs and conducting investigations to determine the types of pollution caused by transportation vehicles on land, air and water. Students are also given opportunities to explore and to suggest methods of controlling or reducing pollution.

**Time Allotment**

Four to five class periods

**Objectives**

Students should be able to:

1. Record information in chart form.
2. State at least one cause of pollution by transportation vehicles on land, water and air.
3. State at least three methods of controlling or reducing pollution.

**Background Information (Teacher Use Only)**

The problem of pollution has cost a great deal in terms of the damage to health, effects on materials (rust and corrosion, repainting, the cost of protective coatings), damage to residential properties (reduction of values of pollution), and damage to vegetation. At the present time most of these costs are being borne by the public.

The exhaust from automobiles and other vehicles of transportation are major contributors to the problem of air pollution. Two of the pollutants emitted from exhaust are lead and carbon monoxide. Cars also provide the ingredients for the smog that bothers your eyes and nose on hot, still days in the summer.

Noise is just as much an air pollutant as dust and smoke because it is harmful to man in his environment, for example: the noises of a great city - traffic, sirens, horns.

The sound level in front of a rock band has been measured as 120 decibels. A noise level of 100 decibels can kill small animals! **37**

From Energy and the Environment by John M. Fowler

**Materials**

Map of local area - showing airport if possible
Three 3" x 5" index cards per pupil
Vaseline
Provided in packet:
Pictures - Life in the City, Airport, What Happened Here?
Story - "An Airplane in My Living Room"
Chart Outline - What Do We Do Now?
Crossword Puzzle - "Give a Hoot. Don't Pollute!"

**Teaching Strategies**

**Introducing the Lesson**

Begin the lesson by saying: "The newspapers, radios and television are often talking about pollution in our communities. What is pollution?" *(List responses. Pollution may be defined as damage to land, air, water or people; or to make air, water, and land unclean.)*

**Developing the Lesson**

"Today, let's look at a picture of a crowded city and see if we can imagine the types of pollution that could be found there."

Distribute copies of Life in the City and ask:

-"What kind of pollutants could you see?" *(Exhaust fumes, smog, crowded traffic, litter, etc.)*

-"What kind of pollutants could you smell?" *(Exhaust fumes, smog, etc.)*

-"Which kind could you feel?" *(Heat, chemicals which irrate the skin, etc.)*

-"What is causing most of these pollutants?" *(Cars or burning gasoline in engines of cars, busses, etc.)*

-"Is there any way that we could improve the situation in the city and eliminate some of the pollution?" *(List ideas on board. Possible responses: More people use busses or other public transportation, use electric cars, have bicycle paths, reduce exhaust fumes, fine people for littering, etc.)*

Continue lesson by telling students that they can become pollution detectives and find out how much pollution is in their community. Distribute three 3" by 5" cards to each student. Tell them that they may choose three places in their community to test the amount of pollution. Places may include shopping

center, factory, highway gas station, home, park, school, etc. Have each students write his/her name and the place he/she is testing on one side of the card and cover the other side with vaseline. They will place the cards in such a manner that they will not blow away. After two days, they will collect the cards and look at what has happened to them.

**Summarizing the Lesson**

Have students make a chart to summarize the types of pollutants they have discussed. Example:

| | Pollutants | | | |
|---|---|---|---|---|
| We: | See | Hear | Smell | Feel |
| | | | | |

File chart in notebook.

**Extended Learning Activities**

Have students make anti-pollution posters and display these around the school.

Invite a car dealer to come to class and explain how car companies are trying to reduce pollution.

Contact the state police department and determine if there is a fine for littering and if so, what it is. Also, ask if it's being enforced.

Collect articles on pollution from newspapers and magazines and share information with the class.

**For Accelerated Learners**

Have students research the type of pollutants found in exhaust emissions. *(The four pollutants include: carbon monoxide, nitrogen oxides, hydrocarbons, and particles of soot, tar and ash.)*

## DAY #2

**Teaching Strategies**

**Introducing the Lesson**

Continue the lessons regarding pollution by examining pollution caused by airplanes. Begin by asking students: "What other kinds of transportation, besides cars, busses, etc. cause pollution?" *(List these on the board. Possible responses: airplane-commercial and private, ships, tankers, pleasure boats, etc.)* "Today, we are going to pretend that we're at an airport and try to find out what type of pollutants we find there."

**Developing the Lesson**

Distribute copies of Airport. Ask students to examine the picture and ask:

- "Are there any pollutants that you could see? Hear? Smell? Feel?" *(Possible responses: jet exhaust, sound of engine, general noise, heat from engines, etc.)*
- "What is causing this pollution?" *(Running of engines, sound of engine, burning of fuel, etc.)*
- "Are most airports located inside the city or outside? *(Outside.)* Why do you think planners do this?"
- "Do you think people like to live near an airport? Why or why not?"
- "Where is our nearest airport located?" *(Locate on local map.)*
- "Have the people in our community ever had problems with the airport?"
- "Have you ever heard of people in other places complain about airplanes or an airport?" *(Possible responses: the Concord noise problem in New York and Washington, D.C.)*
- "What can be done about the pollutants caused by airplanes?" *(List responses on the board. Possible responses: reduce noise of engines, locate airports in non-residential areas, reduce jet exhaust, etc.)*
- "Let's read a story about a boy who lived near an airport and see how he felt about it."

Distribute copies of An Airplane in My Living Room and select several students to read sections aloud while others read silently.

## An Airplane in My Living Room

Gary was sitting in his living room watching his favorite television program,"Sesame Street". All of a sudden he heard a low pitched hum. It grew louder and louder, and the pitch became higher and higher. R-R-R-R-R-R-Z-O-O-O-M! Finally, it became so loud that Gary could not hear what Big Bird was saying.

Gary went outside to see what was causing the noise. It was a jet plane and it was moving very fast!

"Jets sure make a lot of noise!" said Gary.

Gary observed many things about the jet. He could see the smoke from the engine, also he could smell the smoke. He knew a word that tells what they are called - pollution. He could still feel the vibrations and his ears began to hurt.

When something moves back and forth, it is vibrating. When the engine of a jet is vibrating slowly the sound cannot be heard. But as the engine vibrates faster and faster, the sound becomes louder and louder.

Gary thought about the airplane noise and exhaust smoke for a long time. When he went back to his living room, he wrote down some questions to ask his teacher the next day. What questions do you think he wrote?

*(Possible responses:*

1. *What caused the sound of the jet to become louder?*
2. *Why does the noise from the airplane make my ears hurt?*
3. *Does the pollution hurt plants too?)*

Briefly discuss the story by asking:

-"What types of pollution bothered Gary?" *(Noise and exhaust fumes.)*

-"Do you think Gary lives near an airport? Why or why not?"

-"What is a vibration? *(Vibration is back and forth movement.)* Have you ever seen anything vibrate?" *(Guitars and other musical instruments, engines, etc.)*

Tell students that their assignment for the next lesson is to re-read the story and write at least three questions that Gary could ask his teacher.

Summarizing the Lesson

Have students complete the following questions:

Two pollutants made by airplanes are *(noise)* and *(fumes)* .

Airplanes will cause less pollution if we _____ _____. *(Either make better engines or reduce the noise they make.)*

Extended Learning Activities

Take a field trip if possible to the closest airport to see a plane land and take off. Take along a portable tape recorder just to record the sound. Play it back later. Would we mind hearing this sound all day long?

Collect newspaper and/or magazine articles related to community problems with airplanes or airports.

Interview one or more people who live near an airport and ask them how it affects their lives.

## DAY #3

**Teaching Strategies**

**Introducing the Lesson**

Begin the lesson by having students review the types of pollution they have learned about so far. Discuss the types of pollution caused by transportation vehicles on land and in the air. Distribute copies of chart, What Do We Do Now?, and have students complete the chart as you record on the board.

**Developing the Lesson**

Continue the lesson by asking, "What kind of transportation travels on water?" *(Ships, pleasure boats, tankers, sailboats, etc.)*

"Let's look at a picture, What Happened Here? and see if we can find examples of how water is polluted."

Distribute copies of What Happened Here? and have students name the pollutants as you record them on the board. *(Possible responses: oil leak, fish and birds covered with oil, people littering from boats, beach is polluted by oil and ruined for swimming, etc.)*

"If this happened to your favorite beach, what could you do to correct the problem?" *(List responses.)*

OR:

"Sometimes we transport oil to this country in ships we call freighters or oil tankers. Can you think of some reasons why it is necessary to have oil shipped in?" *(Possible answers: to supplement our own supply; it is cheaper to bring it in by ship to some places than to use train or truck; a ship can carry more oil than a truck; some areas which need oil do not have railroad service.)*

Direct students to complete the water transportation section of What Do We Do Now? chart while teacher records answers on the board.

Distribute copies of crossword puzzle on pollution. Review how to work a crossword puzzle. Ask students to try to complete the puzzle. They may work together if they wish. Allow about 10 minutes and then check their answers.

**Summarizing the Lesson**

Ask students to look at the chart, What Do We Do Now? and ask different students to read sections of it.

Remind students to bring their "pollution cards" to school for the next lesson.

## DAY #4

**Teaching Strategies**

**Introducing the Lesson**

Review with the students what they studied about transportation and pollution. On the board write the following and have students write the number and the letter of the correct response:

| | |
|---|---|
| 1. Pollution | a. A pollution caused by airplanes |
| 2. Oil spill | b. One way to have less pollution in the city |
| 3. Noise | c. A pollution caused by tankers |
| 4. Public transportation | d. Less exhaust fumes |
| 5. Better engines | e. Damage to land, air or water |

*(Answers: 1. e; 2. c; 3. a; 4. b; 5. d.)*

Correct the assignment.

**Developing the Lesson**

Have students place their pollution cards on the desk and have students examine them carefully. Note degree of discoloration and texture of vaseline. Group cards according to the amount of discoloration. Record places on the board using chart.

Pollution in Our Community

Heavy
Medium *(Names of places)*
Light

Ask: "What do you think caused the pollution? Where are most of the places with 'heavy pollution' located? 'Light pollution'?"

"Which areas have the cleanest air?"

Have students copy the chart, Pollution in My Community for their notebook.

Ask students to consider what the class could do to reduce pollution in their community. *(Possible answers: collect litter, publish a newsletter to remind families how to reduce pollution, make appropriate posters for various businesses, etc.)*

Choose one activity and make plans to complete it.

**Summarizing the Lesson**

End this series of lessons by reviewing with the students how to make a chart. Then ask them to unscramble the words given below and organize them into a meaningful chart. Write the words on the board or give each student a copy of them.

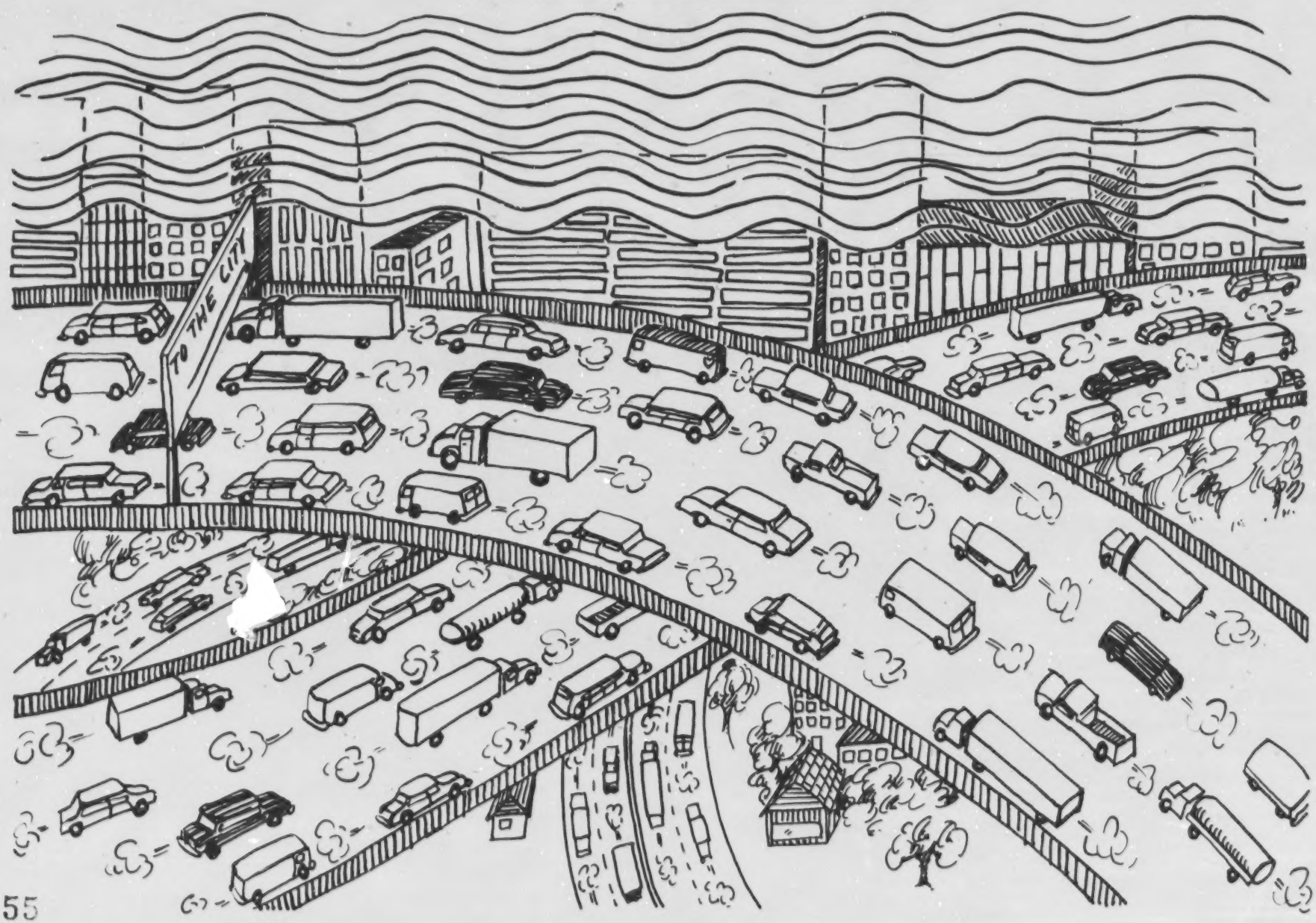
| | | |
|---|---|---|
| land | oil spills | noise |
| exhaust fumes | better engines | quieter engines |
| pollution | airplanes | air |
| water | cars | oil tankers |
| better tankers | | |

*Answer Key*

*Pollution*

| | | | |
|---|---|---|---|
| *land* | *cars* | *exhaust fumes* | *better engines* |
| *water* | *oil tankers* | *oil spills* | *better tankers* |
| *air* | *airplanes* | *noise* | *quieter engines* |

# LIFE IN THE CITY



# AIRPORT

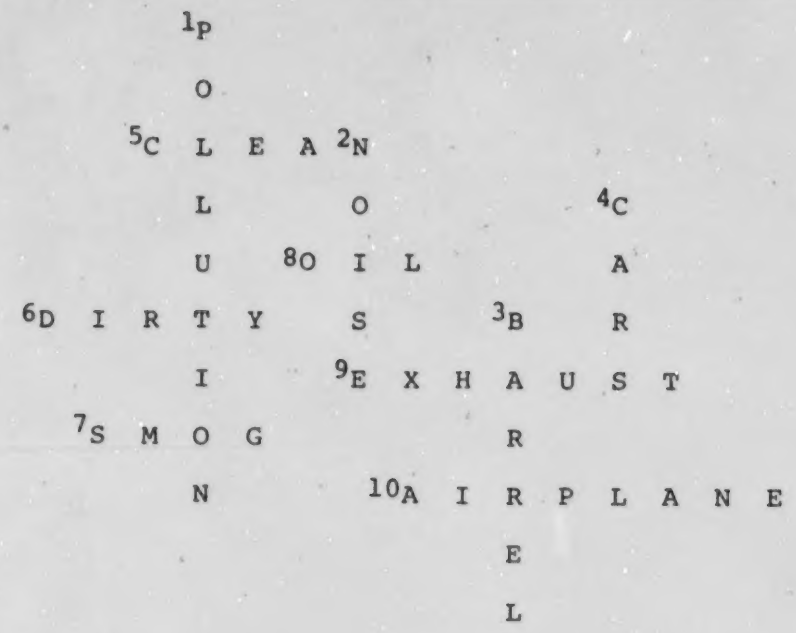
## WHAT DO WE DO NOW?

### Transportation and Pollution

| | KIND | POLLUTION | NEXT STEP |
|---|---|---|---|
| Land | car<br>motorcycle<br>bus<br>train | exhaust fumes<br>noise<br>litter | better engines<br>fines for littering<br>inform people of problems of littering |
| Air | airplanes<br>helicopters<br>private planes | exhaust fumes<br>noise | location of airports<br>better engines<br>control of exhaust |
| Water | ships<br>oil tankers<br>submarines<br>pleasure boats<br>sailboats | oil spills<br>exhaust fumes<br>noise<br>spoiled beaches | better tankers for moving oil<br>quieter engines<br>fines for spoiling beaches |

WHAT HAPPENED HERE?

## Give a Hoot! Don't Pollute!




DOWN:

1. that which causes damage *(pollution)*
2. loud sound *(noise)*
3. we store liquid fuel in it *(barrel)*
4. we drive them *(cars)*

ACROSS:

5. free from dirt *(clean)*
6. not clean *(dirty)*
7. smoke and fog *(fog)*
8. a black liquid fuel *(oil)*
9. fumes from a car *(exhaust)*
10. what we fly *(airplane)*

## Lesson 7 - LOOKING BACK - LOOKING AHEAD

**Overview**

Until recently changes in transportation were an attempt to meet people's needs and wants. Today desirable changes in transportation must also be mindful of our limited energy resources and our ecological responsibilities. As students review a brief history of transportation they will become aware of some of these changes. They will also be given the opportunity to think about and to suggest some future types of transportation which will use energy wisely and will minimize any adverse effect on our environment.

**Time Allotment**

Four to five lessons

**Objectives**

Student will be able to:

1. State at least three criteria for a desireable type of transportation.
2. Evaluate a form of transportation in terms of this criteria.
3. Design a form of transportation in terms of this criteria.

**Background Information (Teacher Use Only)**

The development of transportation has had a profound effect on how we live. There was a time when people lived their entire lives within walking distances of the places where they had been born because their feet were the only means to get from one place to another.

The development of waterways as a major method of transportation was helped by the construction of canals; boats were larger and faster and could carry more than land transport.

Land transport's first major innovation was the wheel, invented about 3000 years ago. By combining animal power and the wheel, people could move themselves and their goods at a rate faster than they could walk. Improved mobility made possible the development of larger communities; the "edge of town" moved outward, slowly.

Air travel began with balloons around 1866. During World War I and after, gas-filled airships became a form of travel for a while. Later jet airplanes emerged as more luxurious forms of transportation.*

* Source: Transit Fact Book, 75-76 edition
American Public Transit Association
1100 - 17th St., Washington, D.C. 20036

**Materials**

Provided in packet:
- Pictures - On Land, On Water, In the Air, Public Transportation, Private Transportation
- Quiz - Changes in Transportation
- Vocabulary Test

**Teaching Strategies**

**Introducing the Lesson**

Begin the lesson by asking: "How did people travel long ago?" *(List ideas on the board. Possible responses: canoe, clipper ship, sailing vessels; by horse, horse-drawn wagons; walking; gliders, large balloons.)*

"Why did these types of transportation change?" *(List ideas. People wanted faster, more reliable, safer types of transportation, wanted to travel greater distances, etc.)*

"What problem has become worse because of the changes in transportation?" *(Pollution.)* What has improved?" *(Can travel to more distant places; can travel faster.)*

"Do you think transportation will continue to change? If so, how?" *(List ideas on the board.)*

"What should a person think about when he/she is designing a new way to travel?" *(Possible responses: cost of using it; types of energy needed to make it run, pollution, appeal, etc.)*

**Developing the Lesson**

"Let's see how much we know about how transportation has changed our lives. Let's look at some pictures that show how transportation has changed." Distribute copies of On Land and ask:

- "What was the first type of transportation on land?" *(Walking and running.)*
- "What type of transportation came next?" *(Riding animals; horseback, etc.)*
- "Are walking and riding animals good forms of transportation? Why or why not?" *(Good exercise, but slow, cover small distances, may be unreliable.)*
- "What type of transportation is shown next?" *(Horse-drawn carriage or stagecoach.)* "Do you think that carriages were comfortable? Would a carriage be faster than walking? Faster than horseback?"
- "What type of transportation is shown next?" *(Train.)* "How is a train better than a carriage? What are the problems of travelling by train?" *(Train may not be available in all places.)*
- "Name the next three types of transportation shown." *(Car, trolley or cable car, and subway.)* "Where were trolleys used?" *(In cities.)*

-"Where are subways used?" *(In large cities.)* "Have any of you ridden on a trolley car? Where? What was it like?"
-"Have any of you ridden on a subway? Where? What was it like?"
-"Have any of you ever seen a very old car? What was it like? Do you think they were comfortable? Safe? Fast? Have cars improved over the years? How?"

-"What is the next type of transportation shown?" *(Bus.)* "Is a bus a better kind of transportation than a trolley? Why or why not?" *(Busses can be more flexible, but will probably be slower.)*
-"What is the next type of transportation shown?" *(Truck.)* "Do we use trucks to transport people or things?" *(Things.)* "What other kinds of transportation also transport things?" *(Carriages, trains.)*

-"In what ways has land transportation changed through the years?" *(It has become faster, safer, and covers longer distances.)*
-"What invention has probably changed transportation more than anything else?" *(Gasoline engine.)*
-"What type of energy resource provides the power for most forms of land transportation?" *(Oil.)* "Do we have enough oil for transportation and other needs?" *(Note that the U.S. must import most of its oil and that oil is becoming scarce.)*

-"How does land transportation affect our environment?" *(This should be a review of pollution lessons and students should be able to mention the exhaust and litter problems caused by people using various forms of land transportation vehicles.)*

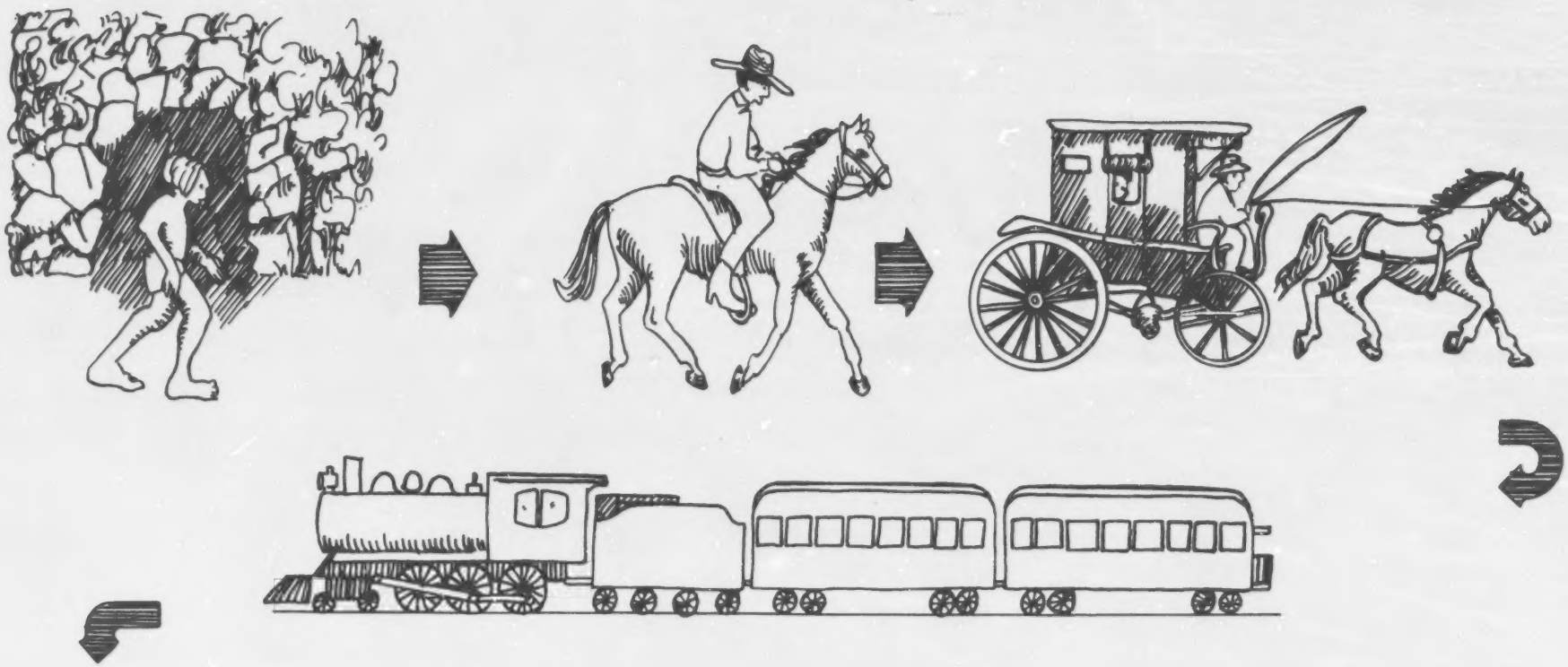
Finish the review of land transportation by having students put a + by the types of transportation that they think are good for people to use and a - by those they think are not desirable for us to use.

Introduce the pictures On Water and In the Air and continue the discussion in a similar manner. Focus the discussion on:
-How the forms of transportation have changed in terms of speed, distance, safety.

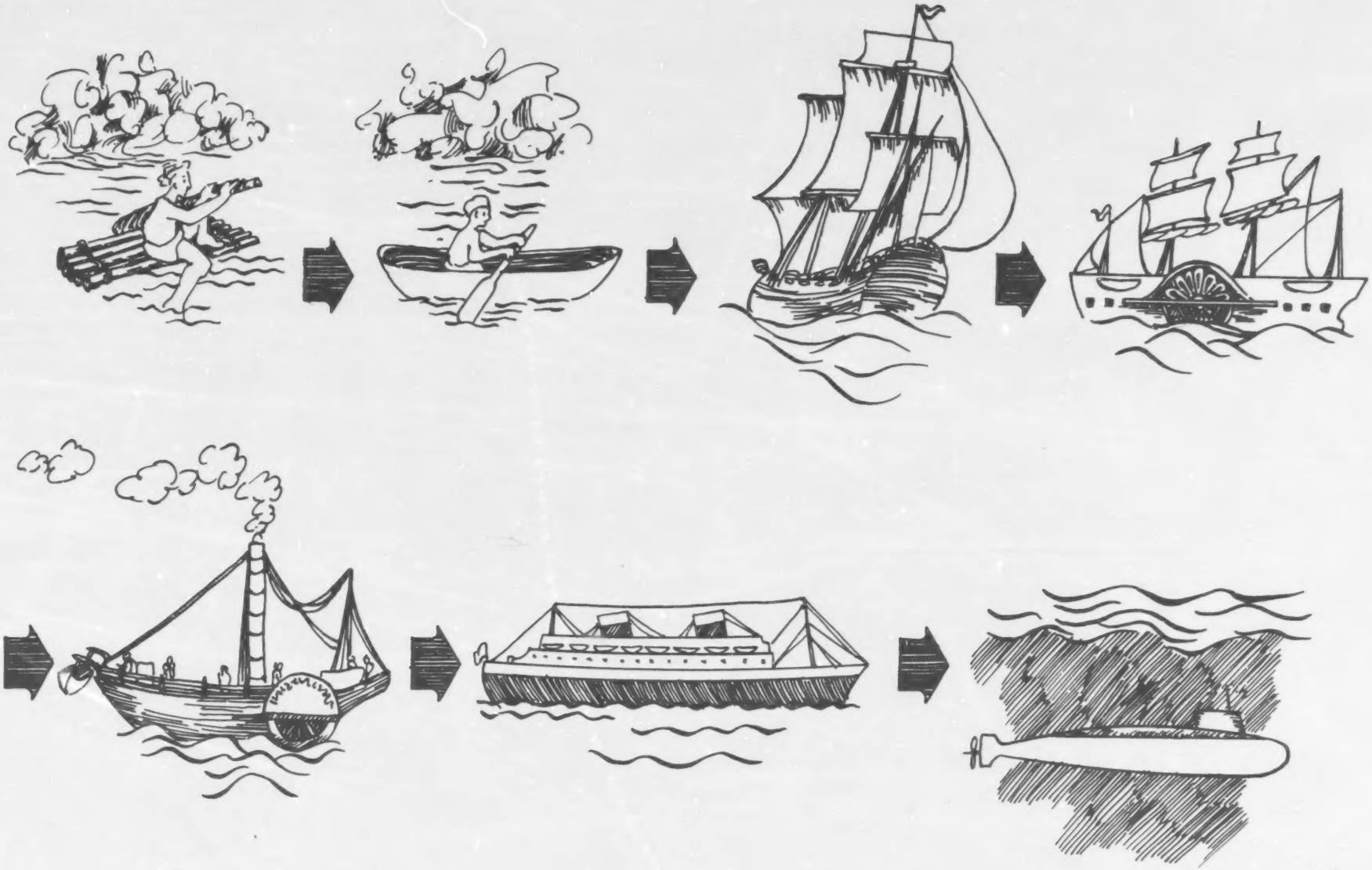
-Which forms transport both people and goods.
-Compare the various forms in terms of speed, safety, distance, energy source and environmental impact.
-Evaluate the desirability of the forms by using the plus (+) and minus (-) ratings.

**Summarizing the Lesson**

End this lesson by asking students to list the qualities of an ideal form of transportation. Consider such characteristics as speed, safety, ease of operation, cost of operation, environmental impact, and availability of energy source.

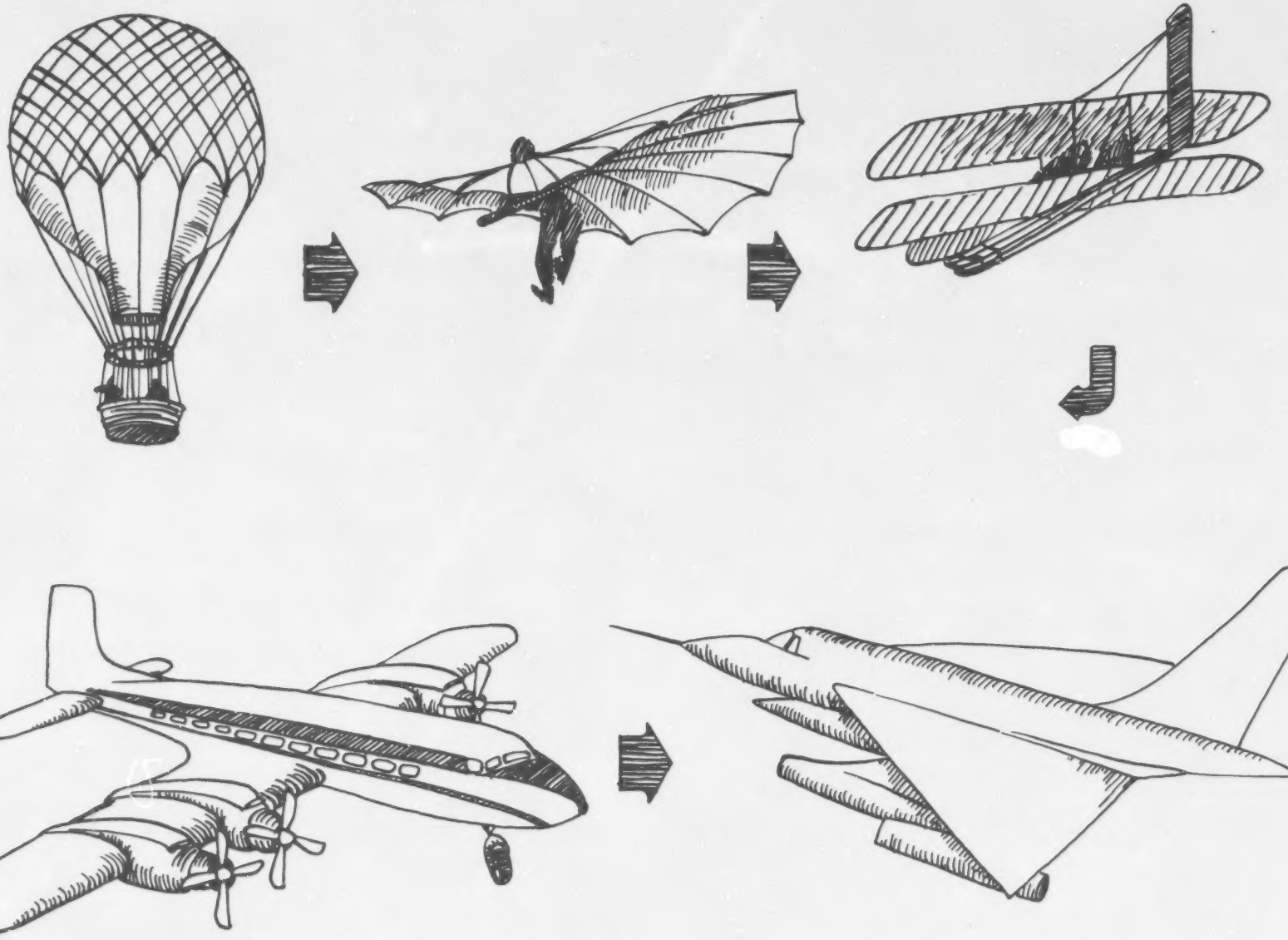


LAND





# WATER



AIR

## DAY #2

**Teaching Strategies**

Review the qualities of an ideal type of transportation and list student responses on the board. (See previous lesson for suggestions.)

**Introducing the Lesson**

Continue the lesson by asking students to locate the pictures On Land, On Water, and In the Air.

**Developing the Lesson**

Review the names of each of the types of transportation depicted. *(Land - walking, horse-back riding, horse-drawn carriage, train, car, trolley or cable car, subway, bus and truck. Water - raft, canal, sailboat, water-wheel/sailboat, steamboat, ocean liner and submarine. Air - balloon, glider, bi-plane, propeller plane, and jet plane.)*

"Today we are going to use these pictures to think about how transportation has changed our lives."

Distribute copies of Changes in Transportation. Using the On Land picture have one student read the sentence aloud. Then ask each student to look at the picture, think about the statement and decide if it is true or false. If true, write T after the sentence. If false, write F after the sentence. Do several with the entire class so that students understand the directions. Complete one section and then discuss and correct the answers. Continue until the assignment is completed.

**Summarizing the Lesson**

Ask students which they think is most important: to go faster, to go farther, or to carry more. Allow several to express their ideas and to explain their reasons.

File the picture and the assignment in their notebook or folder.

## Changes in Transportation

Read each sentence. Write T if it is True.
Write F if it is false.

*Answer Key*

**Land** — Carry More (Amount)

T 1. A train can carry more than a horse can.
F 2. A man can carry more than a horse.
T 3. Busses, streetcars, and subways are mostly used to carry lots of people.
T 4. A car is used mostly to carry one or two people.
F 5. A wagon can carry heavier things than a truck.
T 6. A train can carry lots of people and heavy things.
F 7. The wagon uses the same fuel as the train.
T 8. All forms of transportation use fuel (energy).

**Air** — Go Faster (and Higher)

T 1. The bi-plane (point to the 2 wings on this plane) can go faster than the balloon.
F 2. The balloon can take off faster than the propeller plane.
F 3. The propeller plane carries people faster than the jet.
T 4. The jet was invented because people wanted to go faster.
T 5. The balloon and the glider go slower because they don't have engines.
T 6. The jet engine has the most powerful engine of all air travel.
T 7. The wind is the energy source for the balloon and glider.
F 8. The energy source for a jet is the wind.

**Water** — Go Farther

T 1. Two people paddling a canoe can generally go farther than one person on a raft.
T 2. The wind can make one person in the sailboat go farther than two people in a canoe.
T 3. The steamboat can carry lots of people for many miles.
T 4. The steamboat would be better for an ocean trip than a canoe.
T 5. Bigger ships go farther but they use more fuel.
F 6. You can put a diesel engine in a canoe.
T 7. A nuclear submarine can go farther than a diesel engine ship without refueling.
F 8. A canoe can go farther than a steamboat.

DAY #3

**Teaching Strategies**

**Introducing the Lesson**

Review what was discussed in the previous lesson regarding transportation of the future, i.e., how will transportation change? What should a person think about when designing a new way to travel? (List these ideas on the board.)

**Developing the Lesson**

Show pictures of new forms of transportation. Tell the students they are pictures of new forms of transportation, some that are in use already, and some that are being tested. Discuss the pictures with the class.

Write the following on the board to guide the discussion.

- -cost of purchase
- -cost of use
- -kind of fuels used
- -how fast and far they travel
- -effects on the environment
- -used for public or private transportation
- -used primarily in urban or rural areas or both

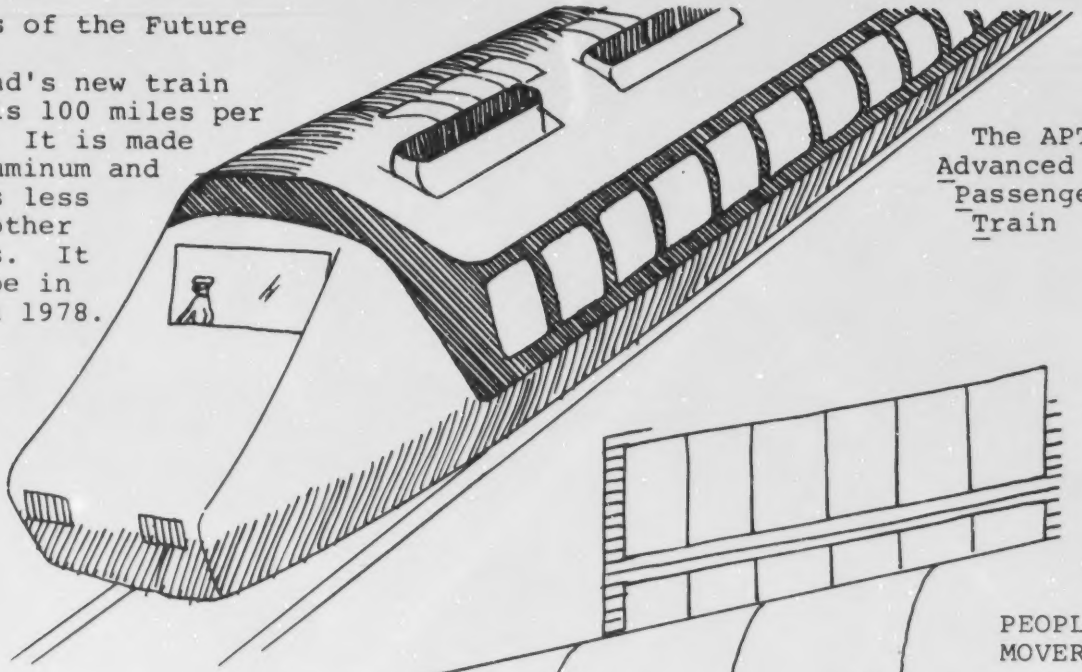
Have students draw a picture of a new way to travel. They should be prepared to tell how it is run, the type of fuel used, its cost and its effect on the environment. Be prepared to share these in the next lesson.

**Summarizing the Lesson**

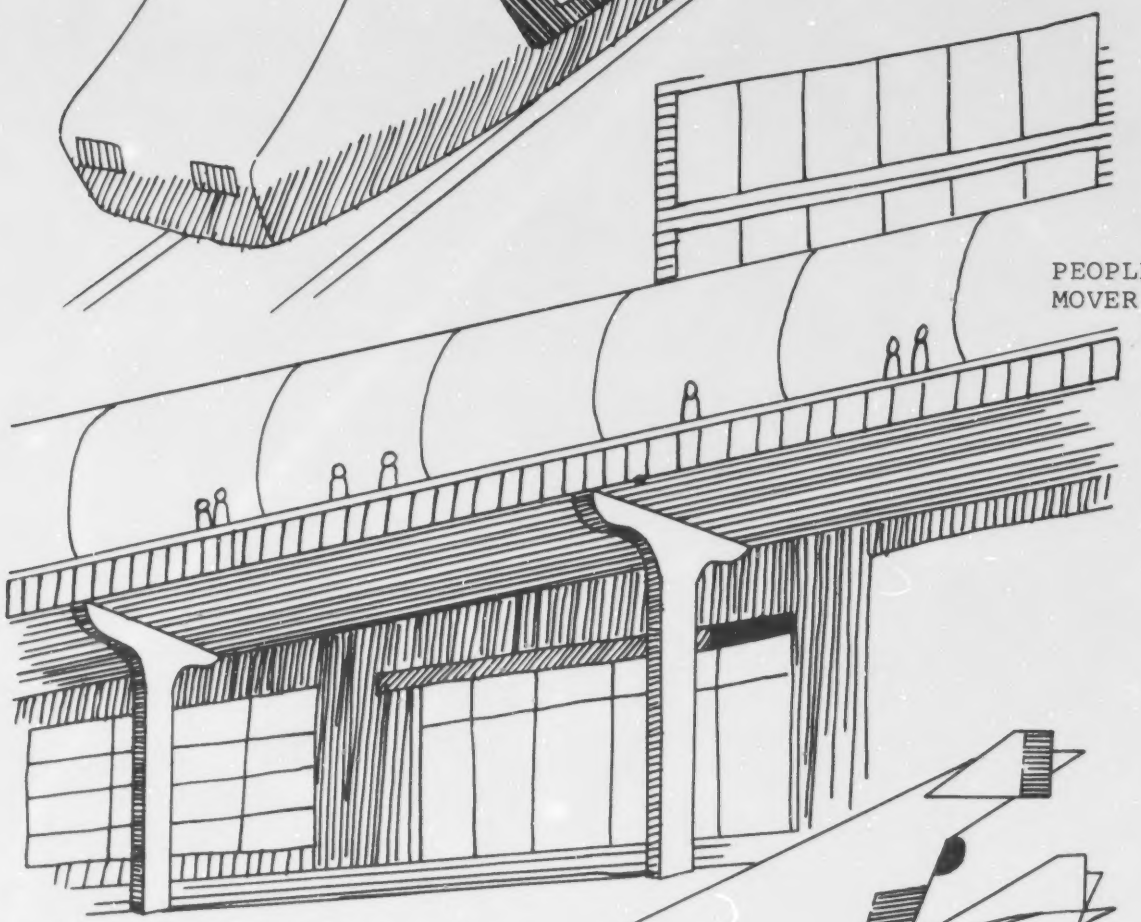
End this lesson by asking students if they think people will continue to travel by car as much as they do today. Give reasons for their responses.

## Trains of the Future

England's new train travels 100 miles per hour. It is made of aluminum and weighs less than other trains. It will be in use in 1978.

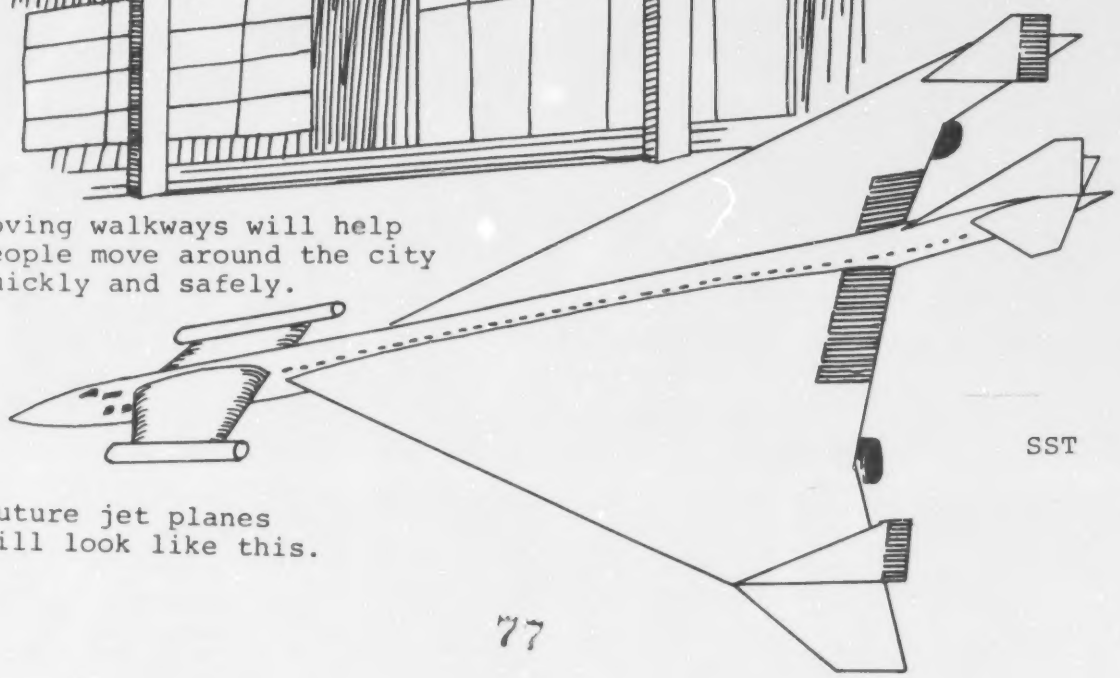


The APT Advanced Passenger Train



PEOPLE MOVER

Moving walkways will help people move around the city quickly and safely.

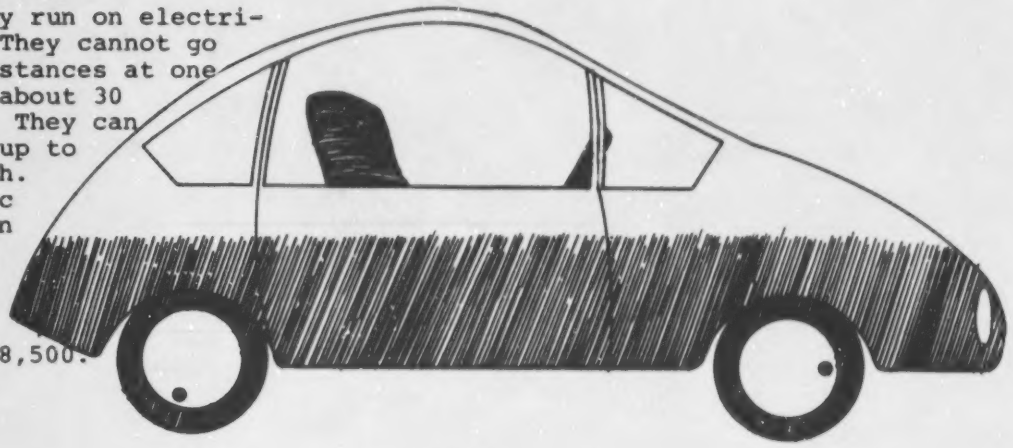


SST

Future jet planes will look like this.

## PRIVATE TRANSPORTATION

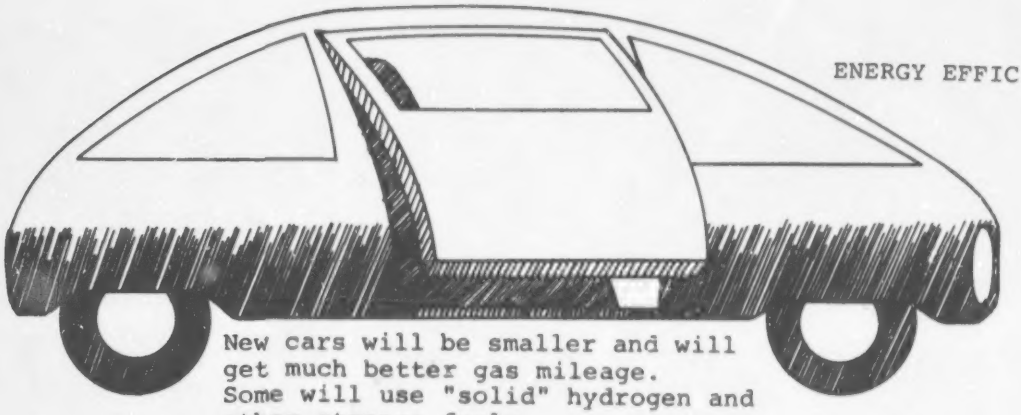
Cars may run on electricity. They cannot go long distances at one time - about 30 miles. They can travel up to 50 m.p.h. Electric cars run on batteries. They cost about $8,500.



Many people are already using the Moped. It is part bicycle and part motorcycle. It goes 150 miles for each gallon of gas. It's small engine moves up to 17 m.p.h. Mopeds cost between $300 and $550.

MOPED

ENERGY EFFICIENT CAR



New cars will be smaller and will get much better gas mileage. Some will use "solid" hydrogen and other strange fuels.

## DAY #4

**Teaching Strategies**

**Introducing the Lesson**

This is the final lesson in this series and of the unit. Begin the lesson by reviewing the qualities of good transportation. Emphasize the need for people to be more aware of our limited supply of oil and of environmental impact.

**Developing the Lesson**

Allow students to share their designs of new types of transportation. Divide the board space into categories - Land, Air, Water or City and Country and display the pictures. If some students would like to make a model of his/her or another student's design, encourage him to do so. Use tinker toys or assemble parts from discarded toys.

Review the concepts and terms used in this unit by playing, "What Am I?" Distribute the vocabulary list which is provided in this packet. Ask each student to select a word and think about its meaning. When ready, he/she gives the meaning and asks, "What am I?" Another student then gives the answer.

Examples:

I am a type of pollution caused by jet planes. What am I? *(Noise or jet exhaust)*

I am a word that means moving people and things from place to place. What am I? *(Transportation)*

Continue until every child has had a turn.

**Summarizing the Lesson**

Write the following sentences on the board and ask students to complete them.

The most important thing I learned about transportation was _____.

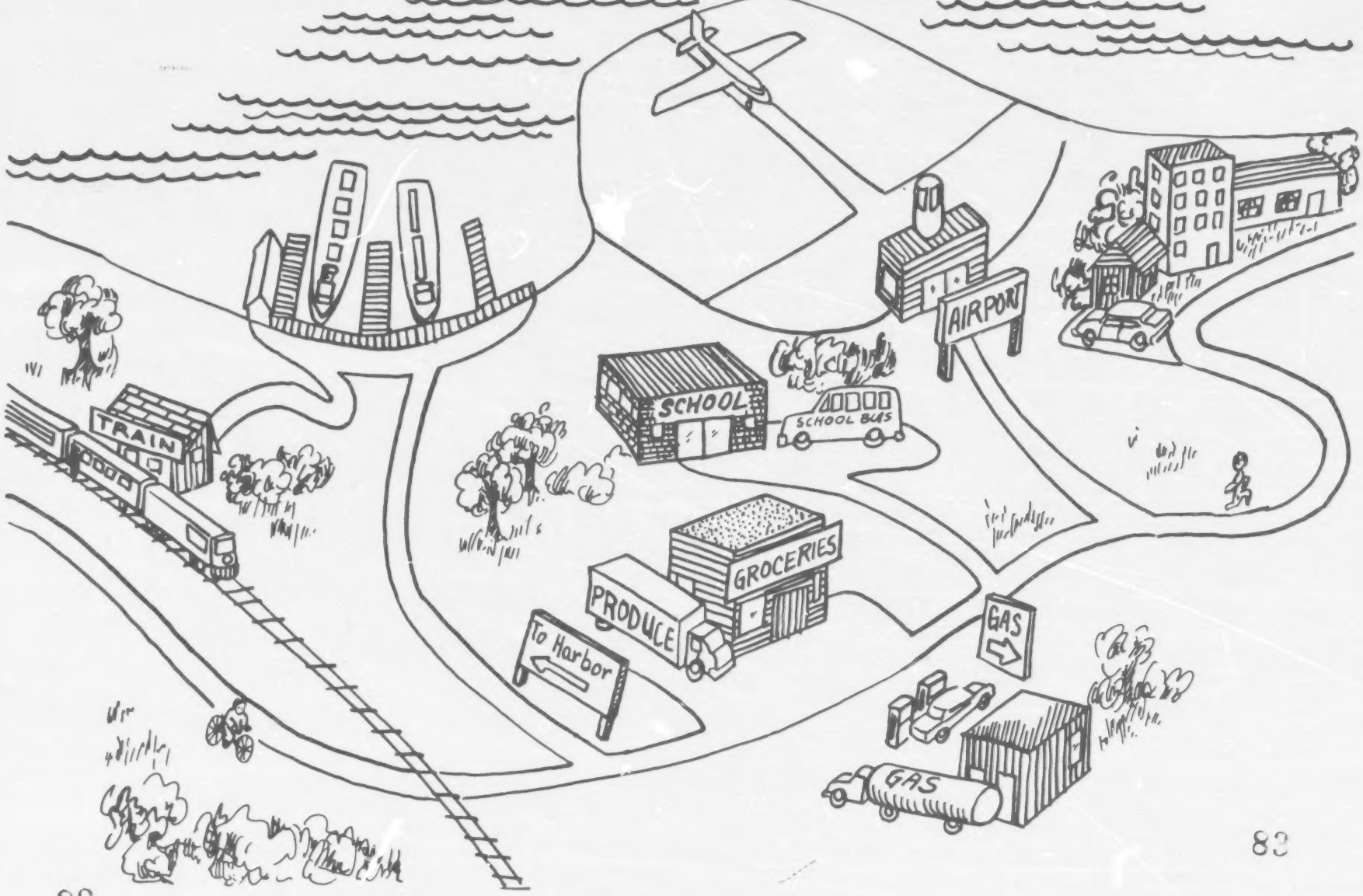
The thing I liked best about this unit was _____.

## VOCABULARY

truck
car
train
airplane
airport
transportation
gasoline
bicycle
passenger
ship
crude oil
refined oil
system
exhaust
litter
engine
carriage
moped
miles per hour (m.p.h.)
taxi
subway
private
public
cost
fare
miles
pollution
motorcycle
diesel fuel
refinery
energy
rural
fumes
tankers
community
distance
fuel
steamboat
submarine
sailboat
ocean liner
bi-plane
glider
propeller plane
jet plane
damage
kerosene
pipeline
flashlight
urban
smog
noise
control
environment
miles per gallon (m.p.g.)

# Student Guide

# ON THE MOVE


AIRPORT
SCHOOL
SCHOOL BUS
TRAIN
GROCERIES
PRODUCE
To Harbor
GAS
GAS

# The Story of Olivia Oil

Hi! I'm Olivia Oil. People tell me I'm very important because I help people. To learn how I can be useful, read my story.

1.
oil field

To find me you must look in the ground. First dig a deep hole. Then use a pump to pull me from the ground. I am called "crude oil" now.

2.
pipeline

Next I go on a trip. I am put in a pipeline (like the Alaskan Pipeline).

OR

3.
tanker

I am put in a big ship called an oil tanker and sent to a refinery.

4.


A refinery is a place where I am changed into ....

5.
gas pump

...gasoline for use in cars, busses and taxis...

OR

6.
diesel pump

...diesel fuel for use in trucks, cars, and ships

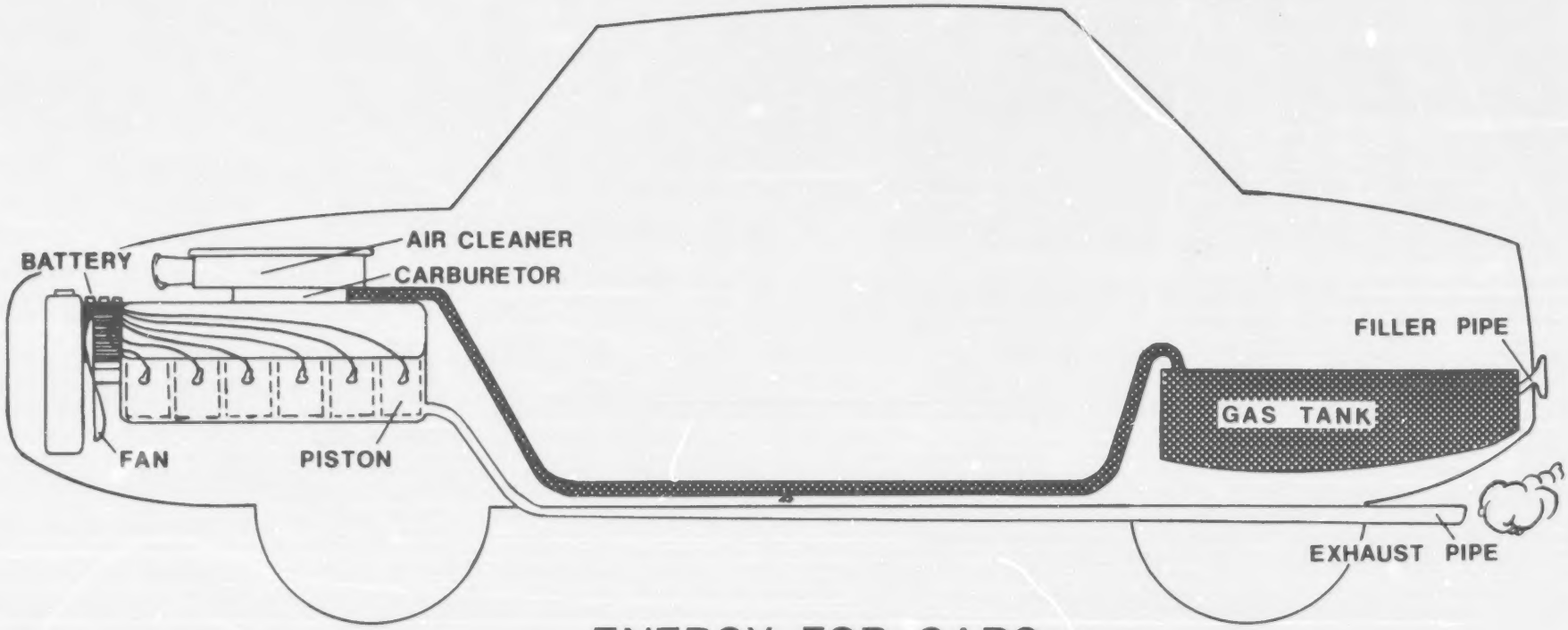
7.
furnace

...oil for heating homes

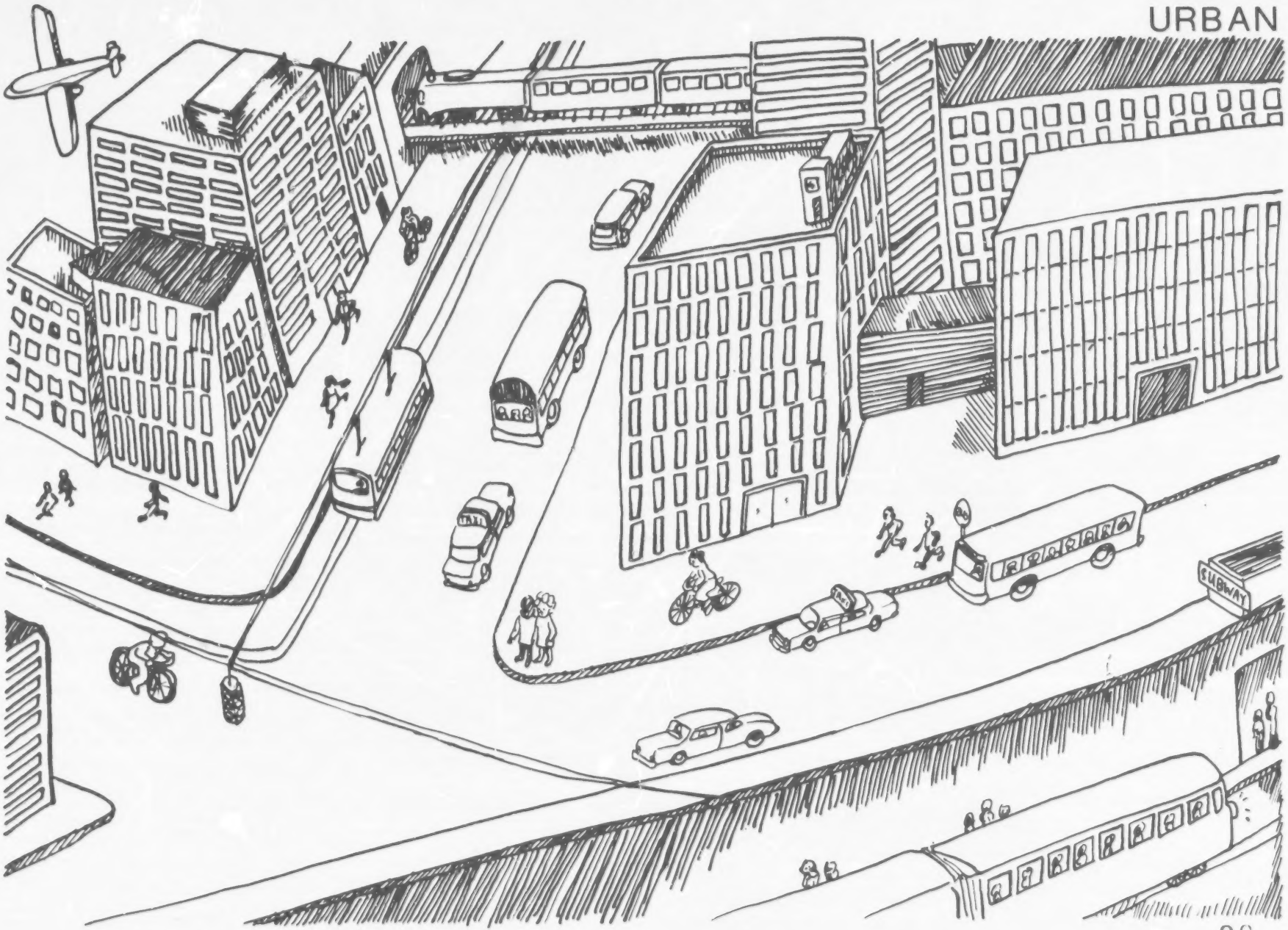
8.

From the refinery, I travel by truck to wherever I am needed.

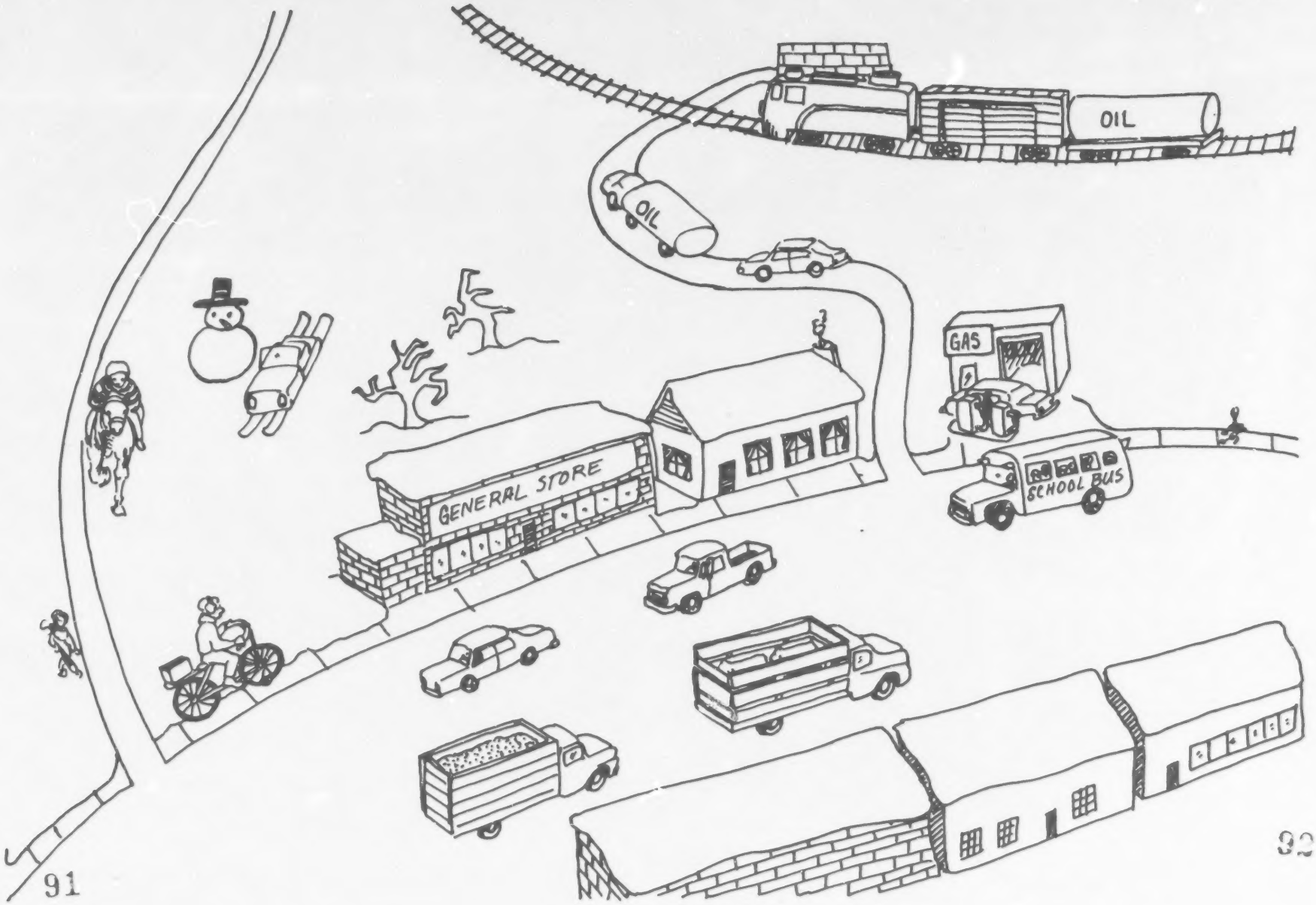
OIL




ENERGY FOR CARS


URBAN
SUBWAY

# RURAL



## SYSTEM SCRAMBLE

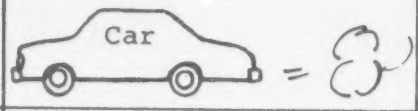
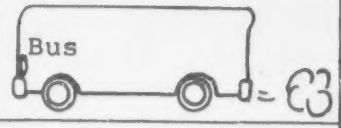
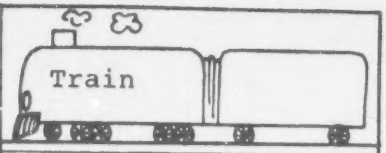
T B S O M B H G O F
T R U C K I U A A Z
V C B O L C K S N N
T A W I A Y A O M A
A G A L N C C R I V
X P Y W A L K I N G
I P L A N E N N O G
P I C K U P V E I T

__van
__bus
__walking
__truck
__taxi

__pick up
__subway
__plane
__oil

__gasoline
__bicycle
__car

## Costs of Getting to Work

| Type of Transportation |  Car |  Bus |  Train |
|---|---|---|---|
| Costs | Gasoline: one-way $ .75<br>Parking 2.00<br>Other cost .50<br>Total Costs | Fare: one-way $ .60<br>Total Costs | Fare: one-way $ .80<br>Total Costs |
| Time | One way 25 minutes | One way 35 minutes | One way 20 minutes |

Work the problems below:

1. How much does it cost Mr. Hernandez to go to work and come home by car?

2. By bus?

3. By train?

4. How many minutes does it take him by car? by bus? by train?

5. Which do you think he should choose?

## How People Get to Work

How far away from home is your place of work?

1st person _____

2nd person _____

How do you get to work?

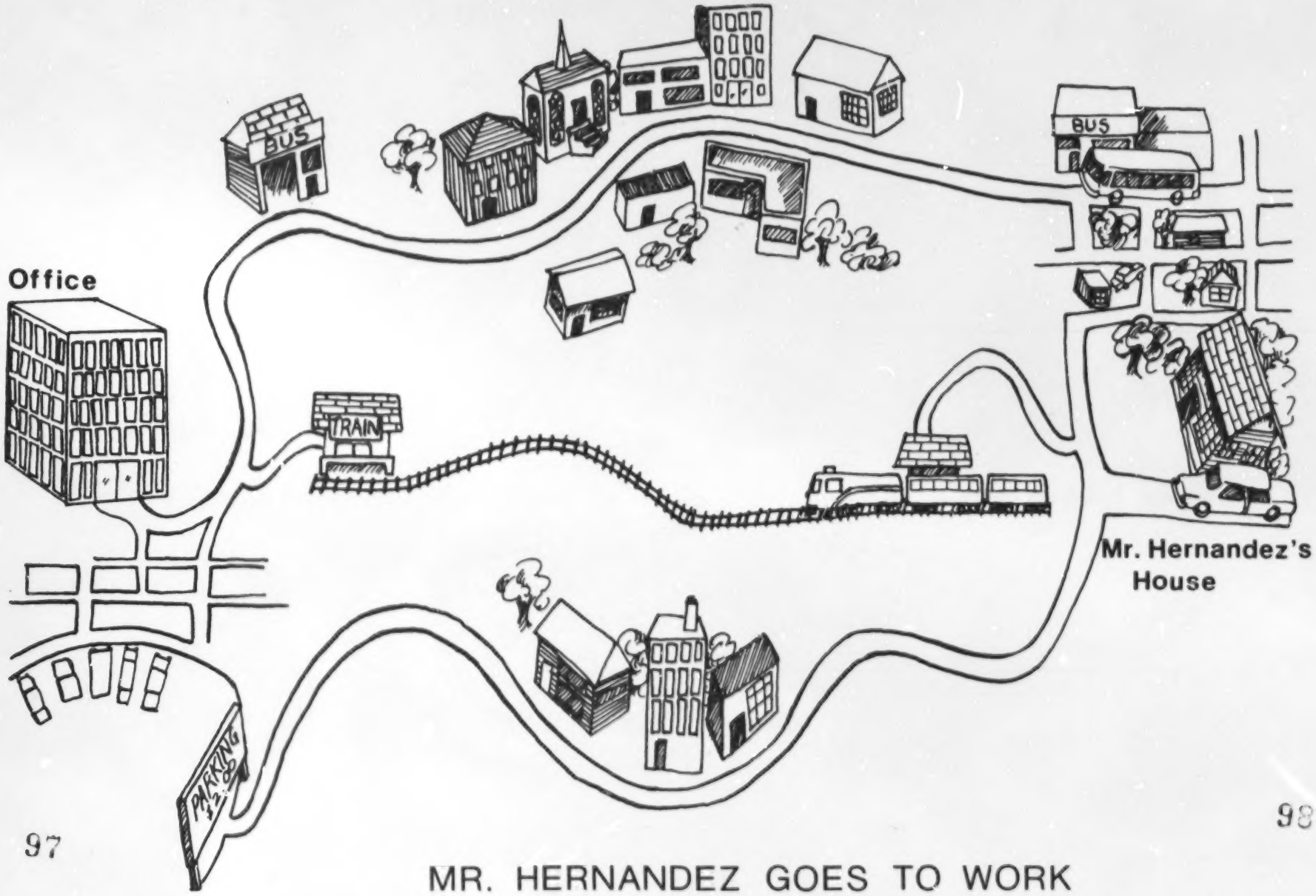
1st person _____

2nd person _____

How much does it cost you one-way?

1st person _____

2nd person _____

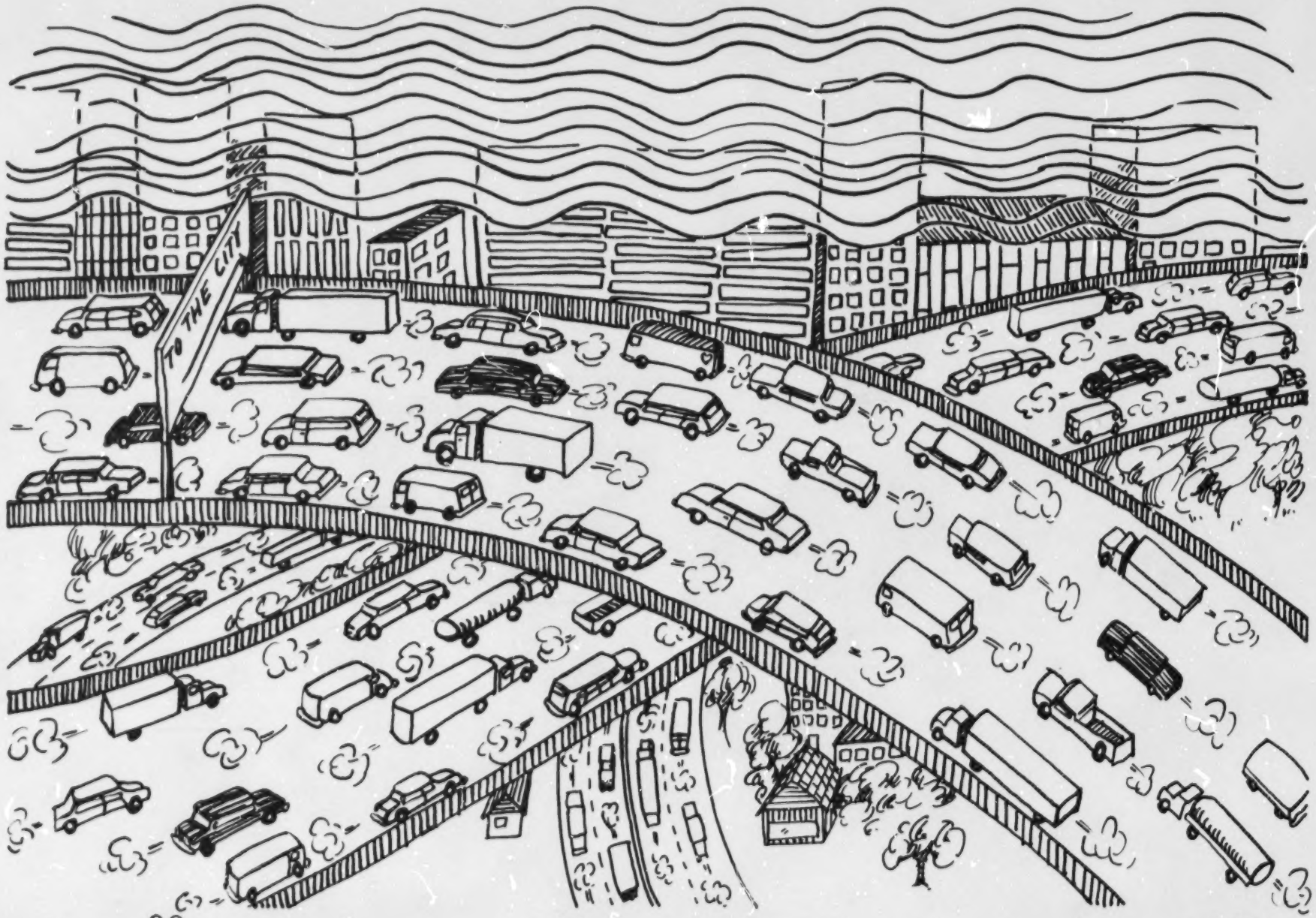







MR. HERNANDEZ GOES TO WORK

# LIFE IN THE CITY



An Airplane in My Living Room

Gary was sitting in his living room watching his favorite television program,"Sesame Street". All of a sudden he heard a low pitched hum. It grew louder and louder, and the pitch became higher and higher. R-R-R-R-R-R-Z-O-O-O-M! Finally, it became so loud that Gary could not hear what Big Bird was saying.

Gary went outside to see what was causing the noise. It was a jet plane and it was moving very fast!

"Jets sure make a lot of noise!" said Gary.

Gary observed many things about the jet. He could see the smoke from the engine, also he could smell the smoke. He knew a word that tells what they are called - pollution. He could still feel the vibrations and his ears began to hurt.

When something moves back and forth, it is vibrating. When the engine of a jet is vibrating slowly the sound cannot be heard. But as the engine vibrates faster and faster, the sound becomes louder and louder.

Gary thought about the airplane noise and exhaust smoke for a long time. When he went back to his living room, he wrote down some questions to ask his teacher the next day. What questions do you think he wrote?

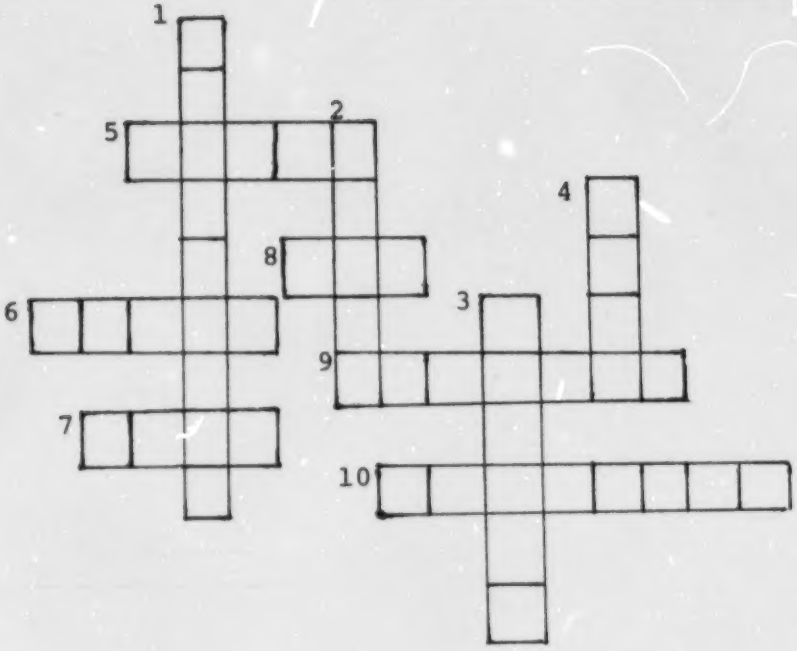
## WHAT DO WE DO NOW?

### Transportation and Pollution

| | KIND | POLLUTION | NEXT STEP |
|---|---|---|---|
| Land | car<br>motorcycle<br>bus<br>train | exhaust fumes<br>noise<br>litter | better engines<br>fines for littering<br>inform people of problems of littering |
| Air | airplanes<br>helicopters<br>private planes | exhaust fumes<br>noise | location of airports<br>better engines<br>control of exhaust |
| Water | ships<br>oil tankers<br>submarines<br>pleasure boats<br>sailboats | oil spills<br>exhaust fumes<br>noise<br>spoiled beaches | better tankers for moving oil<br>quieter engines<br>fines for spoiling beaches |

# AIRPORT

## Give a Hoot! Don't Pollute!



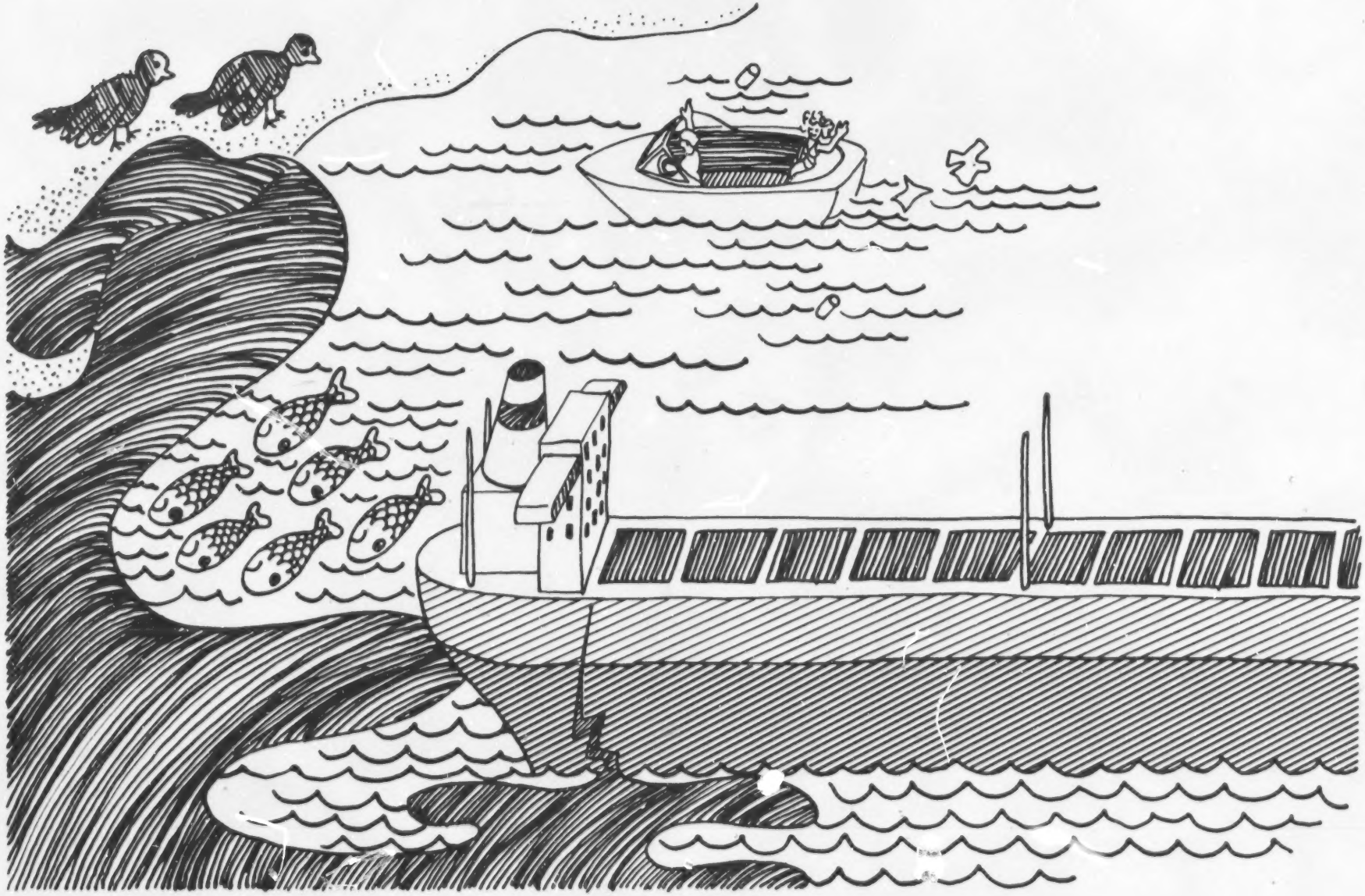

DOWN:

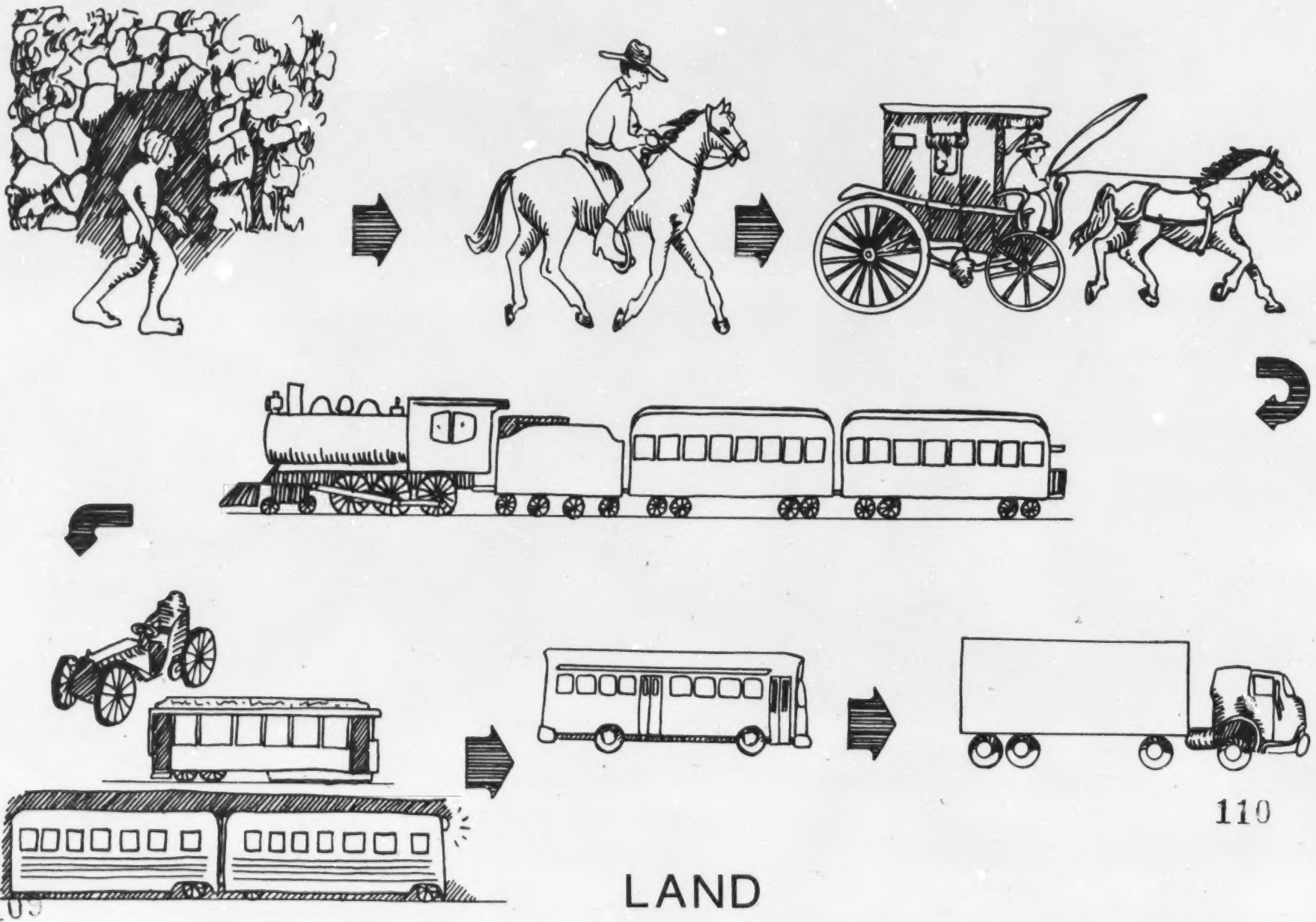
1. that which causes damage
2. loud sound
3. we store liquid fuel in it
4. we drive them

ACROSS:

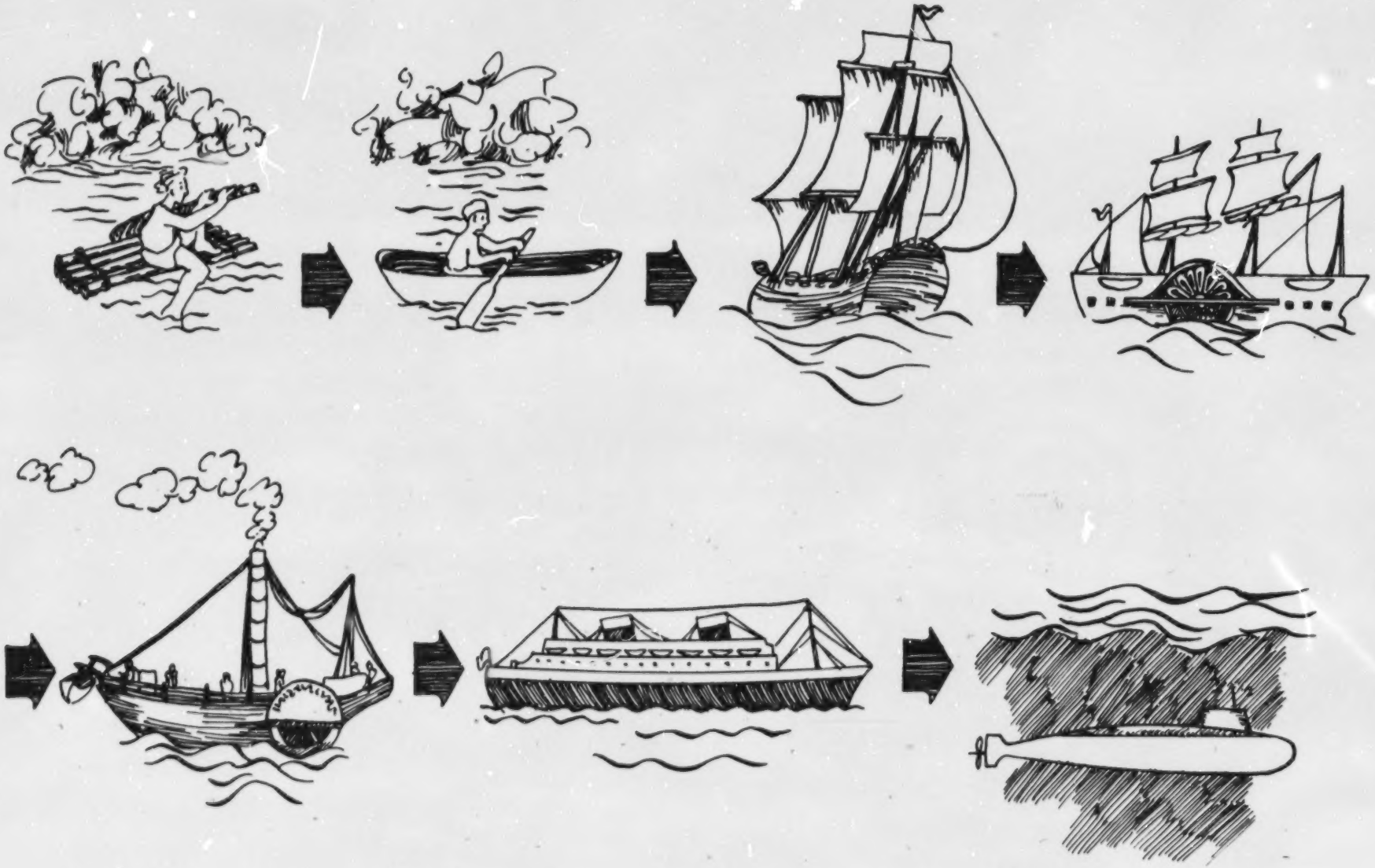
5. free from dirt
6. not clean
7. smoke and fog
8. a black liquid fuel
9. fumes from a car
10. what we fly

WHAT HAPPENED HERE?





LAND



111

WATER

112

## Changes in Transportation

Read each sentence. Write T if it is True.
Write F if it is false.

Answer Key

Land — Carry More (Amount)

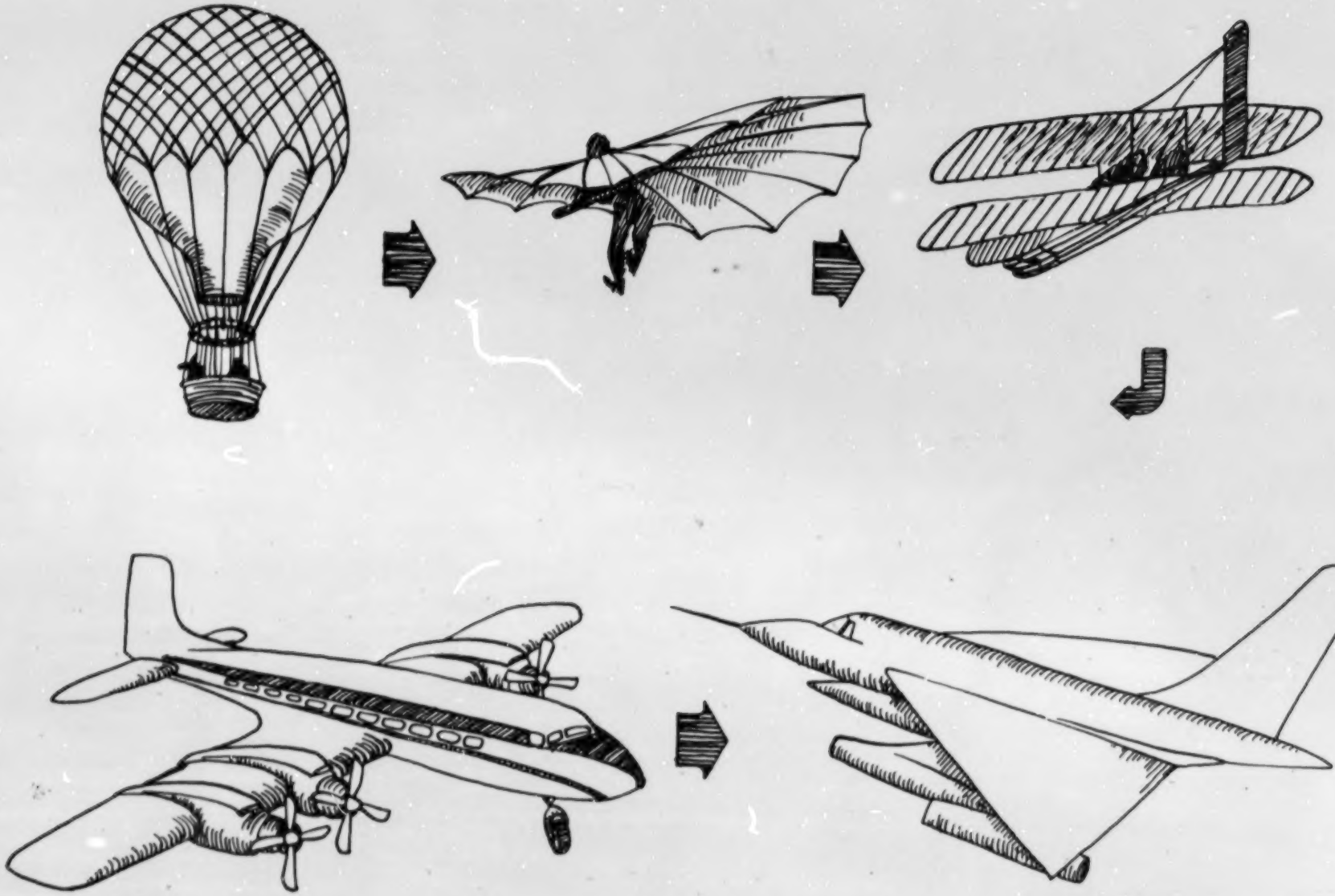
1. A train can carry more than a horse can.
2. A man can carry more than a horse.
3. Buses, streetcars, and subways are mostly used to carry lots of people.
4. A car is used mostly to carry one or two people.
5. A wagon can carry heavier things than a truck.
6. A train can carry lots of people and heavy things.
7. The wagon uses the same fuel as the train.
8. All forms of transportation use fuel (energy).

Air — Go Faster (and Higher)

1. The bi-plane (point to the 2 wings on this plane) can go faster than the balloon.
2. The balloon can take off faster than the propeller plane.
3. The propeller plane carries people faster than the jet.
4. The jet was invented because people wanted to go faster.
5. The balloon and the glider go slower because they don't have engines.
6. The jet engine has the most powerful engine of all air travel.
7. The wind is the energy source for the balloon and glider.
8. The energy source for a jet is the wind.

Water — Go Farther

1. Two people paddling a canoe can generally go farther than one person on a raft.
2. The wind can make one person in the sailboat go farther than two people in a canoe.
3. The steamboat can carry lots of people for many miles.
4. The steamboat would be better for an ocean trip than a canoe.
5. Bigger ships go farther but they use more fuel.
6. You can put a diesel engine in a canoe.
7. A nuclear submarine can go farther than a diesel engine ship without refueling.
8. A canoe can go farther than a steamboat.



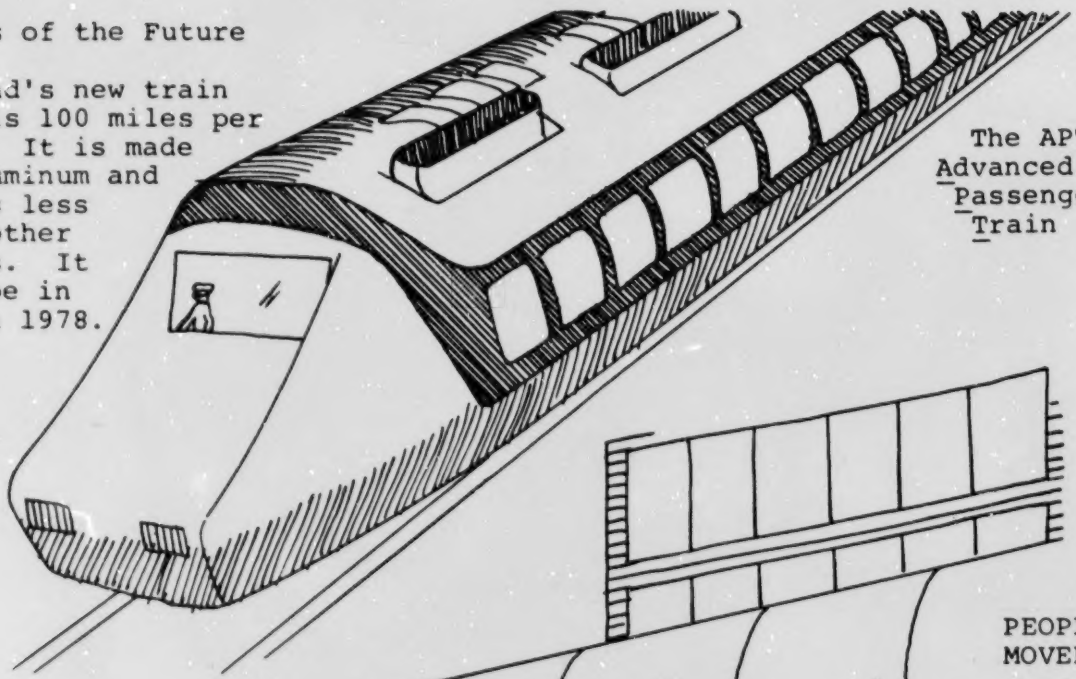
AIR

114

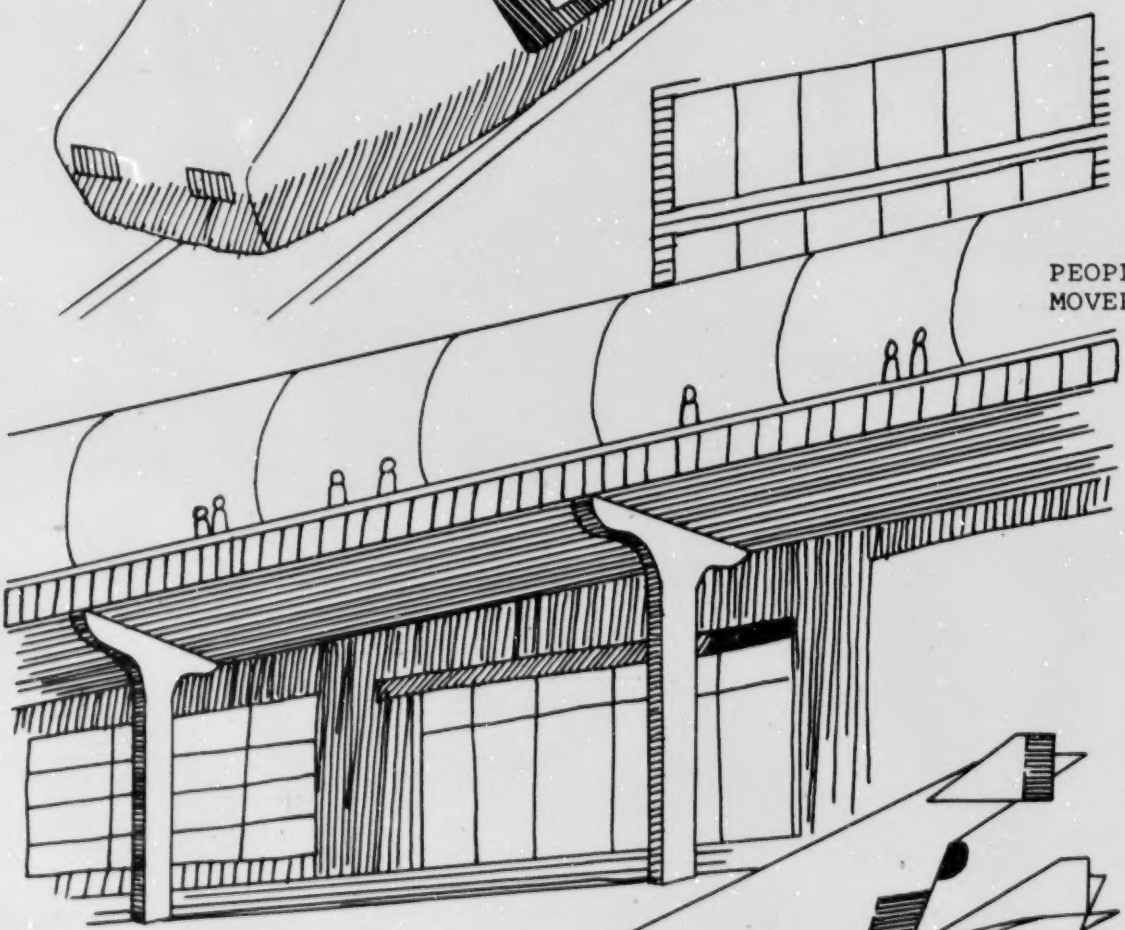
115

## Trains of the Future

England's new train travels 100 miles per hour. It is made of aluminum and weighs less than other trains. It will be in use in 1978.

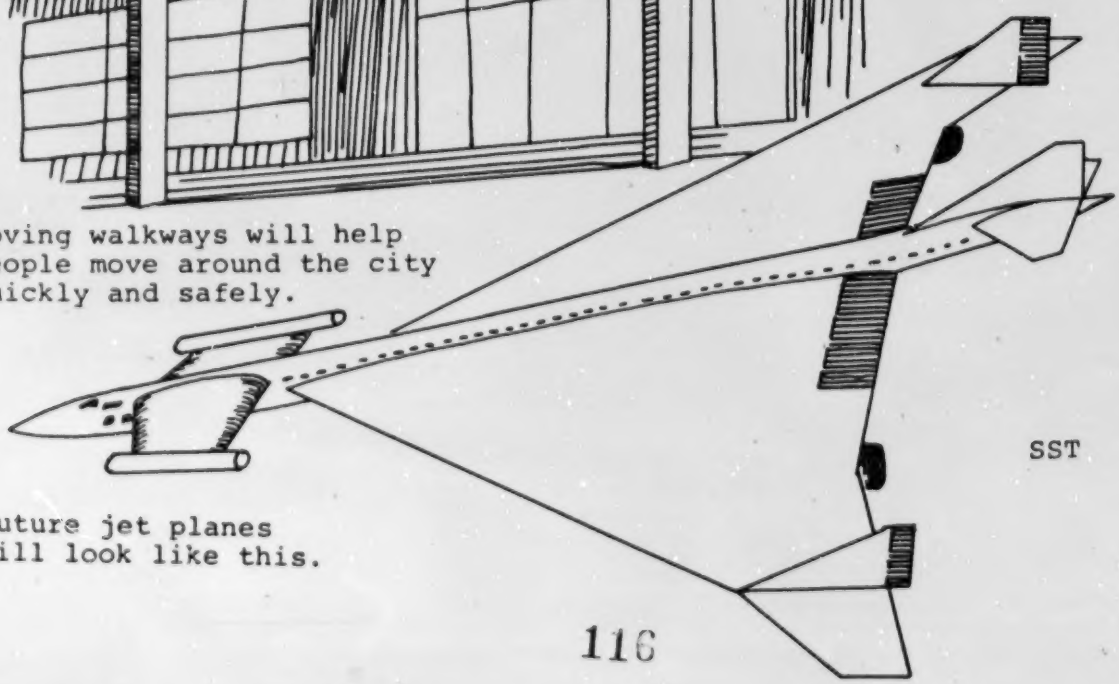


The APT
Advanced
Passenger
Train



PEOPLE
MOVER

Moving walkways will help people move around the city quickly and safely.



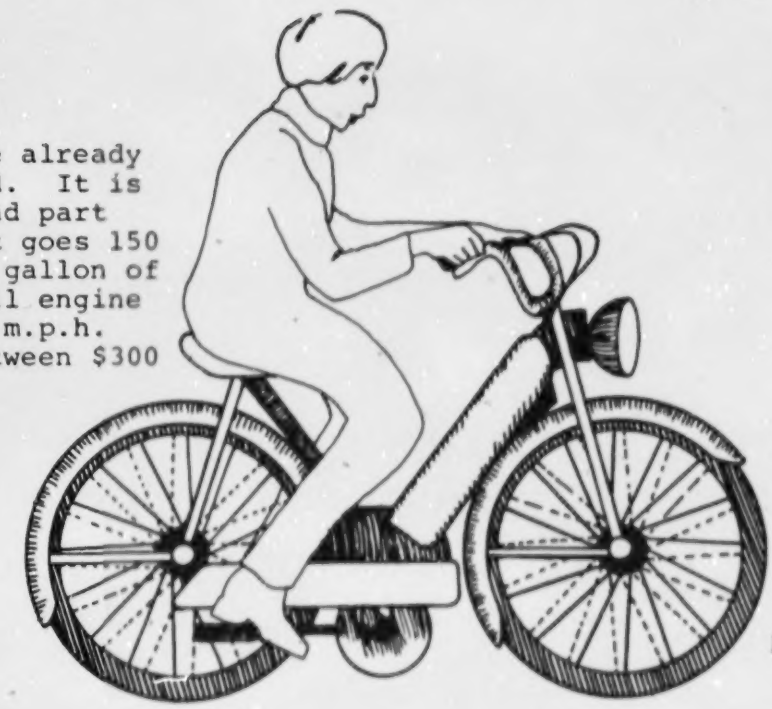
SST

Future jet planes will look like this.

# PRIVATE TRANSPORTATION

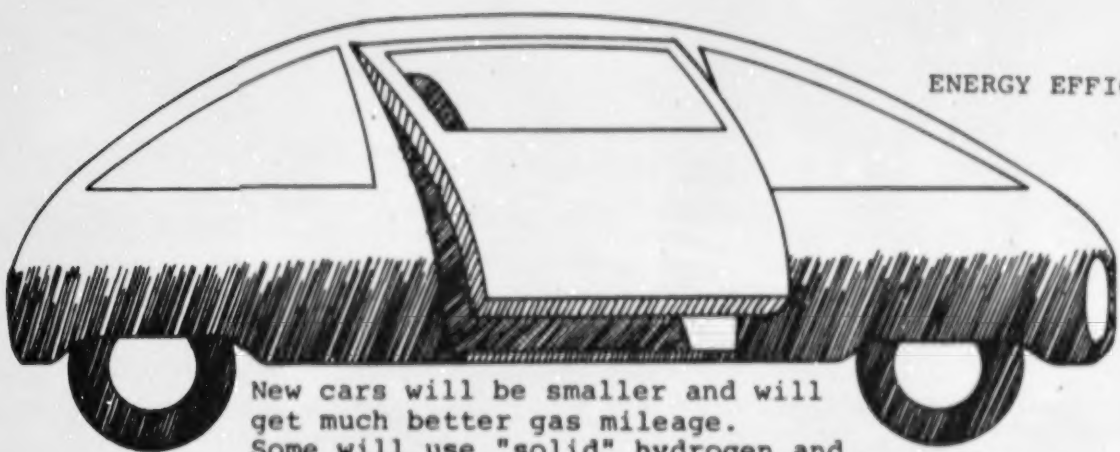
Cars may run on electricity. They cannot go long distances at one time - about 30 miles. They can travel up to 50 m.p.h. Electric cars run on batteries. They cost about $8,500.

Many people are already using the Moped. It is part bicycle and part motorcycle. It goes 150 miles for each gallon of gas. It's small engine drives up to 17 m.p.h. Mopeds cost between $300 and $550.



MOPED

ENERGY EFFICIENT CAR



New cars will be smaller and will get much better gas mileage. Some will use "solid" hydrogen and other strange fuels.

## VOCABULARY

truck
car
train
airplane
airport
transportation
gasoline
bicycle
passenger
ship
crude oil
refined oil
system
exhaust
litter
engine
carriage
moped
miles per hour (m.p.h.)
taxi
subway
private
public
cost
fare
miles
pollution
motorcycle
diesel fuel
refinery
energy
rural
fumes
tankers
community
distance
fuel
steamboat
submarine
sailboat
ocean liner
bi-plane
glider
propeller plane
jet plane
damage
kerosene
pipeline
flashlight
urban
smog
noise
control
environment
miles per gallon (m.p.g.)